2/6 NET.

The Autocar IMPERIAL YEAR BOOK 1914

For Circulation in the Colonies, Overseas Dominions and other countries abroad

Published · by
ILIFFE · & · SONS · LTD. 20. Tudor Street, London. E.C.

OLEO

THE WORLD'S PREMIER PLUG.

Use the famous Oleo and you will ignore ignition troubles.

ALL REACHES.

Brass Plugs.
6 D .. 4/-
7 .. 4/6

American Thread.
7 A .. 5/-
½in. Gas Thread.

7 ALAM 5/-
⅞in. Gas Thread.

Motor Boat Special Water-proof Plug, complete with cap and terminal, 7/-.

Specially designed to suit modern high compression engines.

UNEQUALLED WORKMANSHIP.

Adopted as standard by the largest manufacturers.

ALL REACHES.

Steel Body.
2 BM .. 3/6
19 N .. 4/-
3 D .. 4/-

American Thread.
3 CA .. 4/-
½in. Gas Thread.

3 CALAM 4/-
⅞in. Gas Thread.

Aviation Plug. Gnome Plug, 4/6.

Fit Oleo Plugs on your engine, no other make can do better.

ALL OLEO PLUGS ARE GUARANTEED.

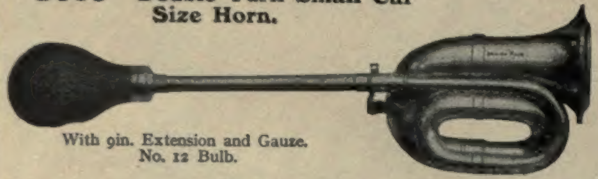
LEO RIPAULT & CO., 64a, POLAND STREET, W.

Telephone: Gerrard 7758. Telegrams: "Ripault, London."

Rec'd June 10/14
fr the Publisher

"DUCO" BRITISH MADE MOTOR HORNS

"DUCO" Double Turn Small Car Size Horn.



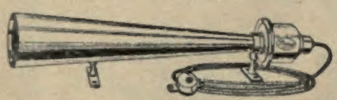
With 9in. Extension and Gauze. No. 12 Bulb.

	Brass, each.	Nickel, each.	Black, each.
No. H4/60. With No. 1 Rigid Bracket, as illustrated	17/6	18/6	19/6
With No. 2 Swivel Bracket	21/-	22/-	23/-

"DUCO" Double Turn Car Horn.

With Double Extension Tube and Gauze. No. 12 Bulb.

	Brass, each.	Nickel, each.	Black, each.
No. H4/61. With No. 1 Rigid Bracket	25/-	26/-	28/-
With No. 2 Swivel Bracket	27/6	28/6	30/6
With No. 3 Adjustable Bracket, as illus.	28/-	29/-	30/-



The "DUCO" Electric Horn.

Gives a penetrating alarm which can be heard half-a-mile ahead. Suitable for town or country use. British-made throughout.

	Brass.	Nickel.	Black.
No. H6/1. "Duco" Electric Horn, 4, 6, 8, or 12 volts. Model 1. Long pattern ..	£3 3 0	£3 7 6	£3 13 0
No. H6/2. "Duco" Electric Horn, 4, 6, 8, or 12 volts. Model 1. Short pattern —	£3 3 0	£3 7 6	£3 13 0

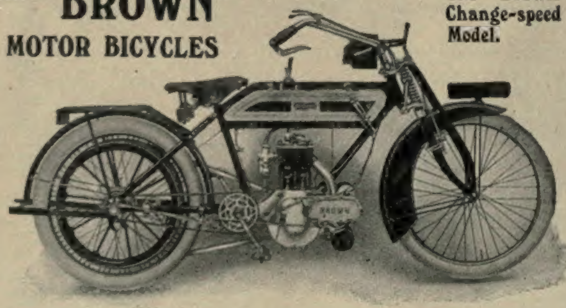
RAYBESTOS gives longer wear than any other lining, and it wears **evenly** down to the last sixteenth of an inch. It possesses more actual **quality** because it is made of **genuine** long fibre asbestos—the **best** raw material money can buy.

Raybestos BRAKE LINING

is treated by a secret process which ensures the highest efficiency, and this process is known only to the manufacturers of **RAYBESTOS.** It is tested **three** different times before leaving the factory. Every inch of fabric goes through exacting tests to determine quality, heat resistance, and co-efficient of friction. Do not accept inferior substitutes.

THE "BROWN" MOTOR BICYCLES

The "Brown" Change-speed Model.



Specification includes. Single-cylinder engine, 86×86 mm. = 499 c.c., developing over 3½ h.p.; adjustable valve tappets, interchangeable M.O.V.; Brown and Barlow carburetter; Bosch high-tension magneto; the "Brown" variable pulley; ⅞in. rubber and canvas or leather belt; dropped frame; patent spring forks; front and belt rim brakes; Clincher "A Won" or Dunlop beaded tyres; pressed steel tank, with combined three-way petrol and drain cock and petrol gauge; separate compartments for petrol (capacity 1½ gallons) and lubricating oil (capacity 1 quart); Brooks' B104/4 saddle; toolbag with full kit; tubular carrier and clip-up stand; footrests, with guide plates; large and rigid mudguards; number-plates.

THE "BROWN" STANDARD MODEL, 3½ h.p.	£47 0
Fitted with Armstrong 3-speed Gear and Free-engine complete ..	£57 0
Fitted with Villiers' Free-engine Hub	£54 10
Fitted with D.H.K. Free-engine Hub	£53 10
THE "BROWN" LIGHTWEIGHT, 2½ h.p.	£36 0
THE "BROWN" MARK VII. TWIN, 3½ h.p.	£50 0
Fitted with latest model Armstrong or Sturmey 3-speed Hub and Free-engine	£58 0

BROWN BROTHERS LIMITED

Codes—ABC, Lieber's, Premier, and Western Union.
Cables—"Imbrowned, London."

THE "WARROW" Reciprocating VALVE GRINDER.

The rotation of the handle produces a reciprocating motion of the spindle, and the valve is moved round just over half a revolution twice to every revolution of the handle. This motion is produced by three wheels only, the driving wheel having interrupted teeth.

The grinding compound is kept evenly spread over the seating, and thus the valve is ground truer and much more quickly than can be accomplished by other means.

Price, **10/6** each.

"CLOVER" GRINDING COMPOUND.

A scientific mixture of abrasive and hard petroleum cutting off that will not dry up. Contains no emery or grit, and, having no magnetic properties, it will not remain in the pores of cast-iron after grinding. Put up in a 4 oz. duplex can, containing two grades: "C" for roughing, and "A" for finishing. Price **1/9** per tin.

THE "Rapid" Valve Truer

For MOTOR CYCLISTS, MOTORISTS, GARAGE PROPRIETORS, &c.
PEARN'S PATENT.

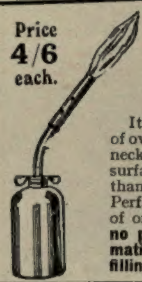
This device has been produced as a result of an extensive practical experience of the difficulties met with by amateur motor cyclists, motorists, and others in truing their engine valves, and also to meet the demand of garage proprietors and engineers generally for a means of truing the valves of internal combustion engines **which will not remove more metal than is absolutely necessary to obtain a good surface, and which will not jar or mark the valve face or score the valve spindle.**

Price **£1** each.

"DUCO" Spring Check Greasers

As supplied to the largest manufacturers.

Price **4/6** each.



The "IMP" Petrol Blow Torch

It produces a perfect Bunsen flame of over 2,000° F., while the corrugated neck largely increases the heating surface and creates a greater pressure than could otherwise be obtained. Perfectly safe, and will not get out of order. **Starts with a match, has no pump or valve, is entirely automatic, and burns two hours on one filling.**

It is surprising how quickly a tyre can be fully inflated with the

"GLEASON-PETERS" GARAGE PUMP.

Just a few easy strokes of the lever are all that is necessary. **"GLEASON-PETERS" PUMPS** are strongly made, free from intricate parts, and will give years of hard service. A reliable gauge is fitted to each model to tell you at a glance when the desired air pressure is reached.

"Quick Service" Model.

"Quick Service" Model

Cylinder, 3¾×6¼in.
Pressure, 125 lbs.
Extreme height, 23in.
Diameter of base, 6in.
No. 12997k.

Price, **£2 5 0**

"Ideal Duplex" Model.

"Ideal" Duplex Model

Finished in brass.
Pressure, 150 lbs.
Price, complete with gauge,

£3 3 0

GREAT EASTERN ST., LONDON, —— E.C.

All prices quoted in these announcements are Retail in London.

"ACCORDIAN" FLEXIBLE PAINT.

The only true remedy for waterproofing and renovating Cape Cart Hoods (canvas or leather), Motorists' Clothing, etc.

No. B52/16.

Buff, brown, black grey.

Quart	**5/6**
½ gallon	**10/6**
1 gallon	**20/–**

"BRITO" MOTOR OIL.

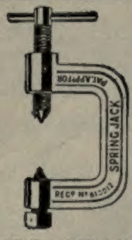
Gives universal satisfaction.

For Water-cooled Motors.

		gal.
No. L80/6.	5 gal. drums	**3/–**
No. L80/7.	10 gal. drums	**3/–**
No. L80/8.	44 gal. barrels	**2/6**

For Air-cooled Motors.

		each.
No. L80/1.	1 gal. cans	**4/6**
No. L80/2.	½ gal. cans	**2/6**
No. L80/3.	Quart cans	**1/4**

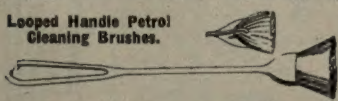


THE "DUCO" SPRING JACK

is a simple yet thoroughly efficient tool for opening the leaves of laminated springs. By its aid rust and dirt can be removed and lubricant introduced.

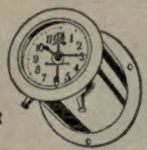
No. S64/1. Each **4/6**

Looped Handle Petrol Cleaning Brushes.



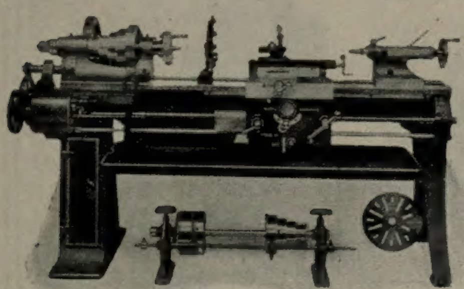
For Cleaning-down Engines, etc.

No. 1.	Small size	each **1/–**
No. 2.	Medium	„ **1/3**
No. 3.	Large	„ **1/6**



MIDGET MOTOR CLOCK.

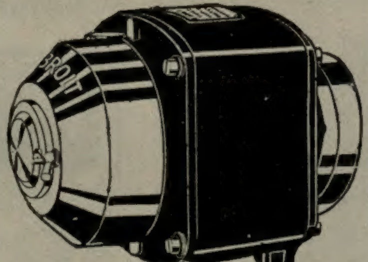
This neat and attractive motor clock has a reliable 30-hour movement, and is specially made to withstand vibration. Price **5/9** each. Brass, plated, or black. With alarm, similar to above, but slightly larger, **7/6** each.



No. 7735. Latest Design High-class Hollow Spindle, Positive Feed, Sliding, Surfacing and Screw-cutting Gap Lathe for Power. This tool has been specially designed for the manufacture and repairs of Motor Cycles and Motor Cars, at the same time making a first-class Toolroom or Experimenting Lathe. C, 6in. × 6ft. B, 5in. × 5ft.

		Price.
Diameter of hole in spindle	1in.	⅞in. C,
Diameter of nose of spindle	2in. Whit.	1⅝in. Whit. **£72 10s.**
Take-in between centres	40in.	33in. B,
Swing over bed	12½in.	10½in. **£57 10s.**

"BROLT" The Dynamo Lighting System that will not go wrong.



The first cost is practically the last cost, as the BROLT Dynamo has the slowest generating speed, and reaches its rated output at a lower speed than any other dynamo. This means reduced wear and tear of bearings, silence, high efficiency, and long life of the carbon brushes, due to improved sparking constants, consequently the upkeep is comparatively small. The **BROLT SWITCH BOARD** is exceptionally neat and compact. Should the tail lamp go out, a red light appears to warn you. Behind the Brolt are years of experience, and for simplicity, brilliancy, and reliability, it easily stands first. Specify the BROLT system on your new car. British-made and fully guaranteed.

Complete BROLT sets from £18 18 0

BROLT Catalogue sent on request.

A POLITE REQUEST FOR A CLEAR ROAD.

A request that is instantly heeded. Instead of a spasmodic noise, which alarms only by reason of its irritating jar, the

"Gabriel" Horn

No. 1, **£2 10s**,	Brass
No. 2, **£3 15s**	„
No. 3, **£5 5s.**	„
No. 4, **£7 7s.**	„

produces a soft, resonant chord exactly resembling the tones of the organ, yet providing ample warning for half-a-mile ahead. Blown by the exhaust, with just a small pedal to press, and no reeds or bulbs to perish, nothing can get out of order. It can be fitted to any make of car, and once fitted it will last a lifetime without expense.

THE "GABRIEL" BUGLE is a distinct novelty in road signals which fulfils its purpose perfectly. Consists of four pipes, tuned to distinct notes, which are operated either separately or simultaneously from a keyboard to reproduce bugle calls or a variety of musical combinations. Price **£8 8s.** Brass.

Does your car wag its tail?

Do you know what a side sway when taking corners means? It means a great wear on your tyres. It means a skid if the road's surface is wet. It means a loss of power, with a possibility of putting your transmission out of alignment. Your remedy is the

GABRIEL REBOUND SNUBBER

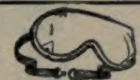
A real shock absorber that positively prevents side sway and holds your car to the road at any speed. The "Snubber" controls the excessive spring action on rough roads, but does not spoil the easy riding qualities on smooth roads.

The "Snubber" prolongs tyre life and protects springs. Easily fixed.

Price from **£3 3s.** pair.

Full particulars on request.

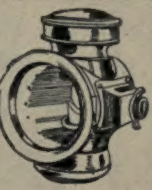
The Editor of "The Motor" writes: "I am perfectly convinced that it is one of the best devices of its kind, and that it efficiently performs the functions for which it is designed."



"VEENA" GOGGLE.

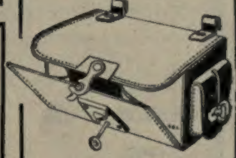
With chenille edges. Made of non-inflammable material, exceedingly light. It is very comfortable.

No. G5/83. Ladies' size, per pair **1/3**
No. G5/84. Gents' size, per pair **1/6**



"VEENA" MIDGET SIDE LAMPS.

Less bail handles. Red rear light. For Cycle Cars and Sidecars. Height 7in. Face, 5in. Depth, 4⅝in. No. L23/3. Per pair, brass, **20/-** Plated, **22/-**



MOTOR CYCLE CARRIER BAGS.

A well finished strong leather tool bag, complete with clips for attaching to carrier. English patent combined hook and lever lock fitted.

No. B1/14. Size 8 x 4¼ x 3½ in. **5/6** each.
No. B12/5. Size 9½ x 5 x 3¾ in. **7/3** each.

"TOWNSEND" GREASE GUNS.

A clean, quick, and easy tool for greasing and lubricating gears, axles, hubs, and other important wearing parts that are usually awkward to get at.

No. S75/9.	1 lb. size, Brass	..	each **24/–**
No. S75/10.	12 oz. „	..	„ **18/6**
No. S75/11.	8 oz. „	..	„ **16/6**
No. S75/12.	6 oz. „	..	„ **14/6**

E&J LAMPS

are mechanically perfect in every detail. They are pleasing in appearance, but, most important of all, give a brilliant light. Made in various styles and sizes to suit practically every make of car.

No. L45/3.

"E. & J" TORPEDO ELECTRIC HEAD LIGHT

Suitable for the highest-grade cars, 11⅞in. fronts, 9¼in. bracket centres.

Brass .. each **47/6**
Nickel .. „ **52/6**

No. L28/1.

"E. & J." TAIL LAMP.

	each.
Brass mounts	**14/–**
Plated „	**15/6**

"E. & J." Leaflet sent on request.

"E. & J." GAS LAMP.

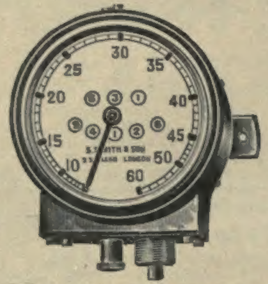
Popular model. Made especially for small cars. High-grade lens mirror.

	Brass.	Nickel.
9 3/16in. front	**35/-**	**40/-**
8½in. front	**30/-**	**35/-**

SMITH'S ROYAL ACCESSORIES

S. SMITH & SON'S ROCK STEADY PERFECT SPEEDOMETERS.

THE "BRITISH."

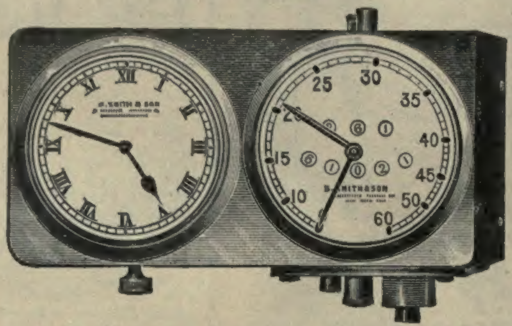


The British. Speed, total mileage, and trip recorder, **£5 15 0.** Dial 4 inches.

The Runabout. Same instrument, without trip, **£4 10 0.**

The Popular. Same instrument, but with Maximum Hand, **£8 8 0.** Nickel **10/-** extra.

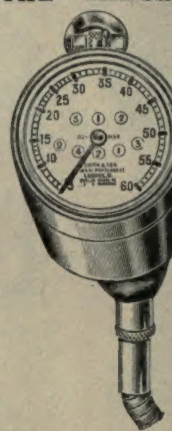
THE "TOURIST."



Type No. 6. A most handsome instrument. Speed, Total Distance, Trip Recorder, and Maximum Hand, combined with reliable 8-day watch, **£14 14 0.**

Type 1a, without watch, square case, **£10 10 0.** Nickel **£1 1 0** extra.

THE "MIDGET."



The Midget. Dial 3½ inches. A reliable Speedometer at a moderate price.

No. A1.	Speed and mileage	**£3 10 0**
„ A2.	Ditto, with trip	**£4 10 0**
„ A3.	Ditto ditto with maximum hand	**£5 10 0**

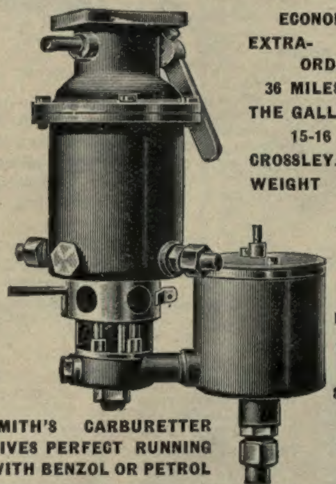
Nickel **5/-** extra.

SMITH'S POPULAR WATCH.

Smith's Famous Two-Guinea Watch.
Reliable 8-day movement, Keyless, **£2 2 0.**
With radium dial, luminous at night, **£3 3 0.**

SMITH'S CARBURETTER.

R.A.C. TRIAL OF SMITH'S CARBURETTER CONSUMPTION OBTAINED



ECONOMY EXTRA-ORDINARY 36 MILES TO THE GALLON ON 15-16 h.p. CROSSLEY. TOTAL WEIGHT 31½ cwt.

TEST TAKEN AT 20 MILES PER HOUR WITH STANDARD JET SETTING.

SMITH'S CARBURETTER GIVES PERFECT RUNNING WITH BENZOL OR PETROL

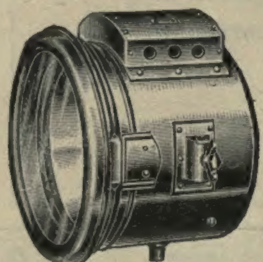
SMITH'S "ROBERT" MASCOT.

The Mascot of the day. Head and Helmet move, giving funny positions.

Brass or Nickel, **19/6.**

A-L GENERATOR

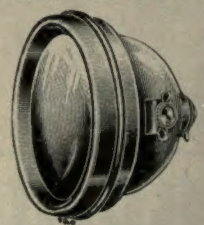
GOLDENLYTE ACETYLENE LAMP.



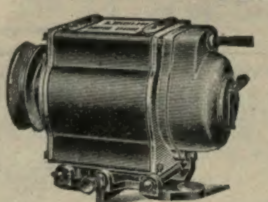
FOG PENETRATING, NON-DAZZLING.

2 HEAD LAMPS, 2 SIDE LAMPS, 1 TAIL, 1 lb. POPULAR GENERATOR. Complete Set, **£11 1 6.**

GOLDENLYTE ELECTRIC LAMP.



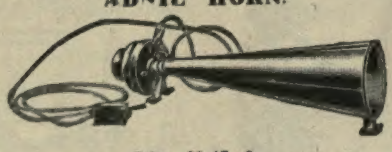
SMITH'S NEW DYNAMO Under T. & M. Patents.



THE MOST RELIABLE SYSTEM ON THE MARKET. 2 HEAD LAMPS, 2 SIDE LAMPS, 1 TAIL' DYNAMO, SWITCH BOARD, ACCUMULATOR.

Complete Set, **£26 18 0.**

ADNIL HORN.



Price £3 17 6.

The best and most reliable Electric Horn. Gives a pleasant, persuasive, yet very penetrative note, and uses practically no current. 4, 8, or 12 volts.

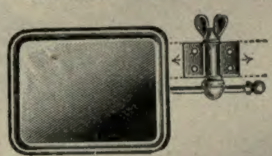
SMITH'S JACK.

THE LIGHTEST & BEST JACK. 3¼ lbs.

4/6.

Wonderful Value.

MOTOR MIRROR.



Undoubtedly the best mirror, as all adjustments are made from one nut. Neat in design.

Oblong, 5 × 6½in. } **15/6.**
Round, 5in. }

Brass or Nickel.

S. SMITH & SON, Ltd., Speedometer House,

179-185, GREAT PORTLAND STREET, LONDON, W., TRAFALGAR SQUARE. & 68, PICCADILLY. HOLDERS OF SIX ROYAL WARRANTS.

Agents for France—KIRBY BEARD & Co., Ltd., 5, Rue Auber, PARIS. Agent for Ireland—C. E. JACOB, 184, Great Brunswick Street, DUBLIN.

Estd 1650 A & O

MONDAY
TUESDAY
WEDNESDAY
THURSDAY
FRIDAY
SATURDAY
SUNDAY

EVERY DAY

some motorist drives home the fact that the best firm from which to purchase an automobile is

ALLDAYS

READ : :
THESE : :
PLEASE : :

8/12/13

Re the car of which we have just taken delivery, we wish to compliment you upon its general excellence. It ran home magnificently, and is by far the best Alldays we have had from you. You will no doubt be astonished to hear that the actual consumption on the homeward journey was 36½ m.p.g.

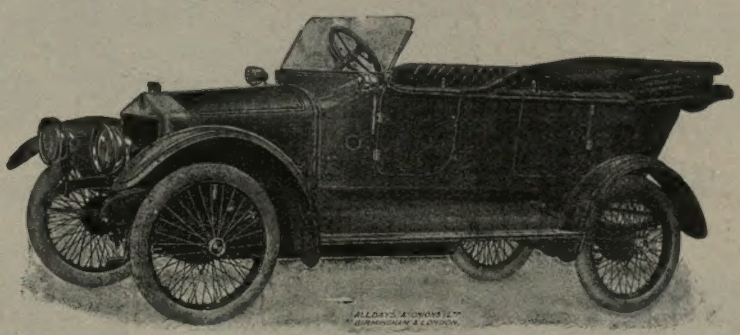
10/2/14

We shall be glad to have particulars and your best terms for your latest cars, including what you call your Midget. We may say that we are still running the Car which we had from you in 1904, and have pleasure in testifying that it has served us well.

Alldays cars require no salesmanship to proclaim their superiority—

A simple demonstration is sufficient to prove to the most sceptical buyer that the "Alldays" is the last word for quality and reliability—No item of equipment essential to comfort has been omitted, and includes :

ONE MAN HOOD, SIDE CURTAINS, WIND-SCREEN, DETACHABLE WHEELS (Wire or Artillery), WITH SPARE WHEEL & GROOVED TYRE, ELECTRIC LIGHTING INSTALLATION including DYNAMO, HEAD LAMPS, SIDE and TAIL LAMPS, HORN, TOOLS, etc.



MODELS.

12-14 h.p. 4-seater	£350	complete.
16-20 h.p. 5-seater	£400	"
25-30 h.p. 5-seater	£485	"

ALLDAYS & ONIONS Pneumatic Engineering Co., Ltd.,

BIRMINGHAM. Contractors to H.M. Government. **London Depot: 58, Holborn Viaduct, E.C.**

BEDFORD CARS   BUICK CARS

FOR ALL COUNTRIES CLIMATES & CONDITIONS

BUICK CARS.

Chassis and Coachwork built by the Buick Motor Co., Michigan, U.S.A. **The Motor** 15/18 h.p. with the unique **design** of **overhead valve system** makes for **greater efficiency, flexibility, and genuine accessibility.** The engine responds instantly to the throttle which gives a wide range of control on top gear. Perfect automatic lubrication, with Bosch high tension magneto and Zenith carburetter offer unequalled advantages. The well sprung chassis is specially designed to meet all road and climatic conditions. Buick Cars are to be found all over the world. It is light yet sturdy to resist the severe usage it will receive. Road clearance 10½ inches under front axle, the lowest part. Wheels are fitted with detachable rims. The improved body (2-seaters and 5-seaters) is of wood with metal sheathing, spacious seats well provided with springs and upholstery to insure comfortable riding. **The prices of Buick Cars are low, and we can justly claim to offer best value in the low-priced class.**

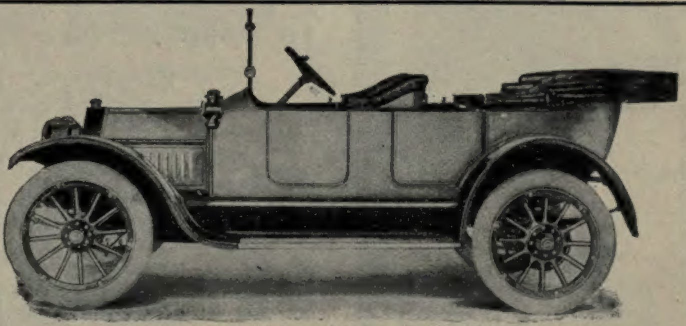
Light, powerful, swift, silent, possessing hill-climbing power with low cost of upkeep, they give permanent satisfaction to the owner.

BEDFORD BUICK CARS.

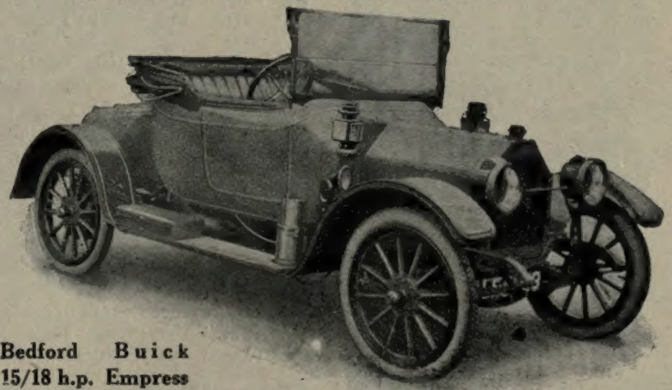
Buick Chassis with English Bedford Coachwork the product of our London Works, combines in the highest degree the qualities of dignity, symmetry, and comfort. Both in design and finish it is worthy to rank with the highest-class carriage work. 15/18 h.p. 2-seaters and 5-seaters with various types of bodies have earned the high reputation as the smartest cars on the road. **Value for price is unequalled, and it is truly the car of "Luxurious economy."** All models are sold with the following comprehensive equipment:—

> Hood, screen, five lamps and generator, speedometer, jack, tyre pump, horn, tools and tyre carrier.

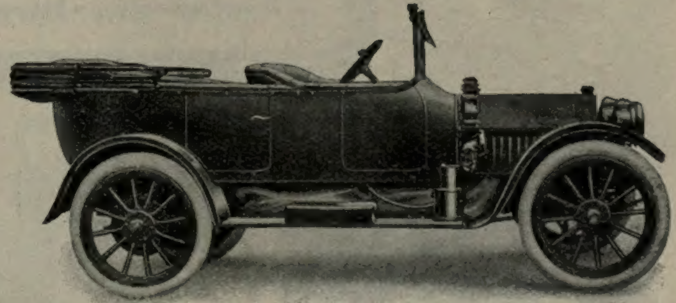
Buick Cars (shipped direct from New York) fitted with four plain Clincher Goodyear Tyres. Bedford Cars with 2 plain and 2 steel studded Michelin Tyres



Buick 15/18 h.p. Model Ex25, £245.



Bedford Buick 15/18 h.p. Empress Victoria, £285.

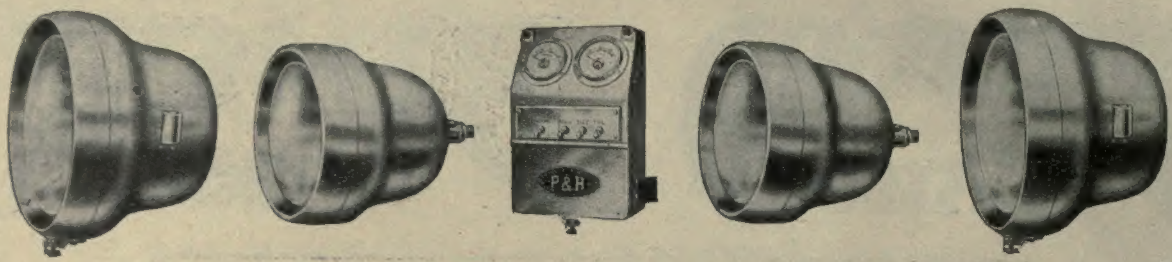


Bedford Buick 15/18 h.p. Torpedos Olympus, £295.

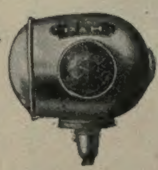
We are desirous to appoint strong selling Agents.

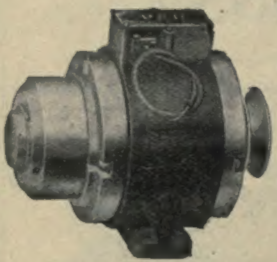
Write for full particulars and Catalogue.

GENERAL MOTORS (Europe), LTD.,
Bedford House, 136, Long Acre,
London, W.C. - - - - England.



The "P&H" DYNAMO LIGHTING SYSTEM.





¶ When buying Lighting Equipment, don't fail to inspect the popular

"P&H HIGHEST GRADE"

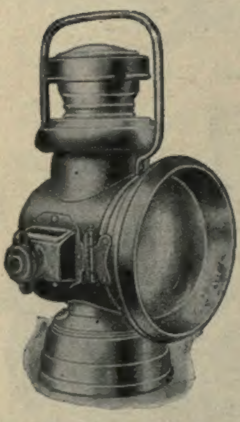
PRODUCTIONS.

¶ The "P. & H." Range comprises ELECTRIC and ACETYLENE Sets suitable for *any* and *every* Car — all BRITISH MADE productions of "Highest Grade" — and all guaranteed to give efficient and reliable service.

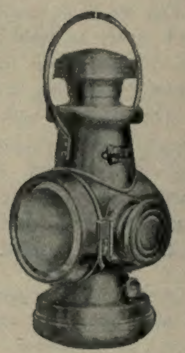
— For the Motorist who requires a clean, economical, and troubleless "Lighting" service, we particularly recommend "The P. & H. Dynamo Lighting System" — the most compact, economical, and reliable "Electric Lighting System" on the market. It comprises 2 Head Lamps, 2 Side Lamps, Tail Lamp, Dynamo, Battery and Switch. Prices from **£24 : 5** to **£26 : 5** the complete Set.

— For further particulars of this and the "P. & H." Acetylene Sets, please write for "Explanatory Booklets."

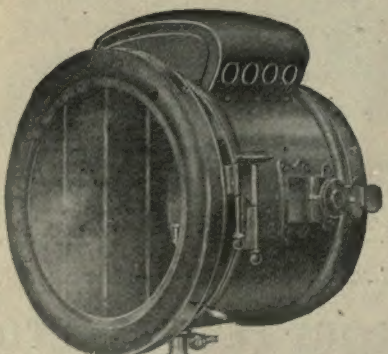
Powell & Hanmer, Ltd., Chester St., Birmingham.



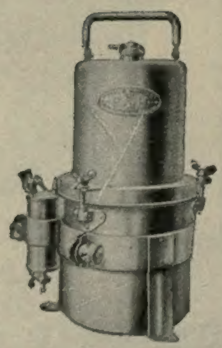
Side Lamp. No. 540. Nickel, 33/6. Brass, 30/- per pair.



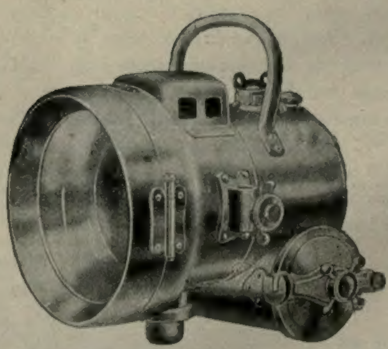
Tail Lamp, No. 545 Nickel, 20/- Brass, 18/-



Acetylene Head Lamp, No. 600. Nickel, 85/- - - - - Brass, 77/6.



Generator - - No. 640. Nickel, 45/- Brass, 41/6. In Wooden Box - 52/-.



Self-contained Acetylene Head Lamp, No. 500. Nickel, 45/6 - - - - Brass, 41/6.

R.H.S.

MORS.

Why the 12/15 h.p. MORS is the best value on the market to-day. It has Four Speeds, Five Sankey Detachable Steel Wheels, Underslung Springs, 765 x 105 Tyres, Best English Bodies, complete with Rotax Leitner 12 volt. Dynamo Lighting Set, **£365.**

We are the Sole Concessionnaires for these models for the United Kingdom, take second-hand cars in part payment, and supply on easy terms.

MARLBORO' MOTORS, 404, EUSTON ROAD, LONDON, N.W.

Telephone: North 2943.

B.R.C. ELECTRIC

Dynauto SETS

WHY THEY ARE SUPERIOR.

FIRST. Because at any speed an absolutely CONSTANT VOLTAGE is maintained, thereby enabling all lamps to be lighted direct from the Dynamo. The battery only acts as a reserve to supply current when the car is stationary.

SECOND. Because by the "DYNAUTO" principle, a battery of only about half the capacity of those used with other systems is needed, thereby saving expense and making an appreciable difference in weight and accommodation.

THIRD. Because the battery, being always kept fully charged by the Dynamo, will last much longer than with other systems.

FOURTH. Because the current (amperage) supplied to the Battery by the "DYNAUTO" is always in proportion to the voltage in the former, so that the action of the dynamo is entirely automatic, and the battery can never be overcharged. No attention is therefore required from the driver.

Many more "Reasons" could be cited, but the above show clearly the principal advantages of the "DYNAUTO" Electric Lighting Sets. The "DYNAUTO" is compact and self-contained, and can be easily fitted to any car.

Our complete catalogue will be sent post free upon request. It contains suggestions and full information for complete lighting equipments.

FENESTRE, CADISCH & Co., 171, Gt. Portland Street, London, W.

'Phone: Mayfair 2818. 'Grams: "Spurroyal, Wesdo, London."

Rotax

BRITISH MADE

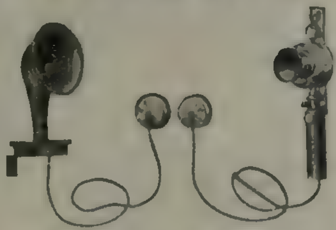
ACCESSORIES

Rotax Acetylene Generators.

Drip Feed System Simple and efficient working. Consist of three parts only. In three sizes. Heights 9½, 11, and 11¾in. In brass, nickel, and black plated finishes. Prices from **21/-** to **42/6** each.

Rotax Brightlight Projectors.

Powerful Lamps, fitted Mangin Mirrors and Parabolic Reflectors. Four sizes, 10½, 9, 7¾, and 6¾in. In brass, nickel, and black finishes. Prices from **£2 15 0** to **£9 2 0** per pair.



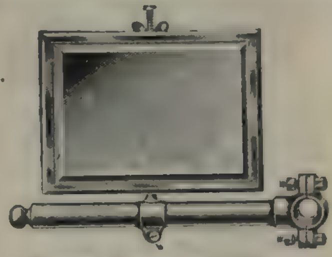
The Rotax Autophone.

A highly powerful telephone giving loud and clear communication from the interior of the car to the chauffeur. For working with the Rotax and other 12-volt Lighting Sets. price **£2 15 0.** Also made in 4, 6, or 8 volts.

This Rotax Electric Lighting Equipment is a modification in miniature of the renowned Leitner System adapted very extensively by the leading British Railways and Motor 'Bus Companies. There are in all eight sets, ranging in suitability from the large closed carriage to the small light car. These sets comprise: Dynamo, Switchboard, Accumulators, Head Lamps, Side Lamps, and Tail Lamps. In the large sets Carriage Lamps, Dash and Inspection Lamps, and Electric Horn form additional items. The prices range from **£22 6 6** for the small set in brass finish to **£50 8 0** for the large set in ebony black finish, Fitting materials included. Special Spun Glass Accumulators are supplied for tropical countries at a slight extra charge.

Prices are retail in : : London : :

Illustrated Catalogues free and : : post paid on request . :



Rotax Driving Mirrors.

Oval pattern, in two sizes, 7 × 4in., Brass, price **16/6**; Nickel, price **19/6.** 8 × 5¾in., Brass, price **19/6**; Nickel, price **21/-** Also circular and square patterns from **11/3** each.

Rotax Brougham Lamps.

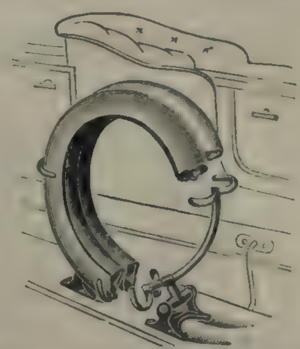
Taper form, quite a new pattern. Height 10in., max. diameter 4in. No. 1179. Polished Brass, **£4 4 9**; Nickel, **£4 8 0**; Black, **£4 12 0** pair. Complete with fittings, bulbs, and armoured wire

Rotax 'Electrolight' Head Lamps.

In three sizes — fronts 9, 11½, and 13in. Brass, Nickel, or Black finish, prices from **£5 18 0** to **£10 15 0** pair.

Torpedo Side and Tail Lamps from **36/-** per set, brass. Complete with fittings, bulbs, and armoured wire.

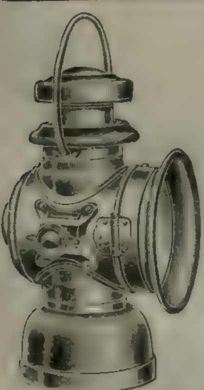
ROTAX WIND SCREENS, HOOD MATERIALS, BODY FITTINGS.



Rotax Automatic Carrier.

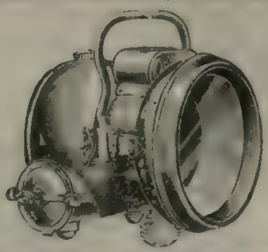
For tyres and spare wheels. Neat and simple, no straps required. Easily bolted to footboard. Takes tyres any diameter. In four sizes, for 90, 105, 120, and 135 mm. treads. Prices from **52/6** per set complete. Single patterns from **31/6** per set.

Rotax Motor Accessories Co., Great Eastern St., London, E.C. England. Works: Willesden Junction



Rotax Oil Side Lamps.

Strongly built. Standard Pattern Height 11½in. Price **36/6** per pair, brass finish. Also in nickel and ebony finishes or black enamelled. Tail lamps in above finishes, prices from **8/6** each.



Rotax Self-contained Acetylene Lamps

Fitted Mangin Lens Mirrors, Parabolic Reflectors. In three sizes. Front diameters 9, 8, and 7½in. Polished Brass. Price **£3**, **£3 10**, and **£5** each. Nickel at slight extra charge.

Rotax Horns

First-class quality in three finishes, brass, nickel, and black. Prices as illustrated **21/-**, **23/-**, **27/6** each. Models also supplied with extension or flexible tubing and non-rubber bulb for hot climates. Extensive range of horns.

THOMSON - BENNETT

THE ALL-BRITISH MAGNETO.

To suit all engines.
Car. Cycle. Marine. Stationary. Agricultural.

ON ADMIRALITY LIST.

1-Cyl. Models. 2-Cyl. Models. 4-Cyl. Models.
From £4 0 0. From £5 0 0. From £7 10s.

Full Catalogues on application.

NEVAJAHS TO SAVE SPRINGS.

Thousands in use in all parts of World.

Prevent Bumping and Swaying.

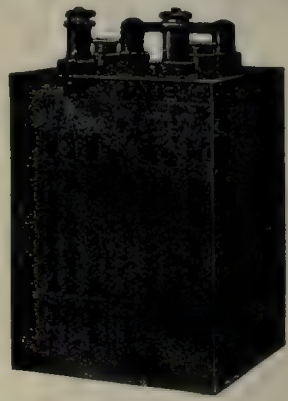
Save Springs on Roughest Roads.

For Medium Cars, 16/6. For Heavy Cars, 18/6 and up.

Thomson-Bennett, Ltd., B'ham.

ACCUMULATORS

for Ignition or Lighting.



Stand the heaviest wear and tear.

Extensively used on lorries, etc.

Supplied under customers' labels.

Special Terms to Trade.

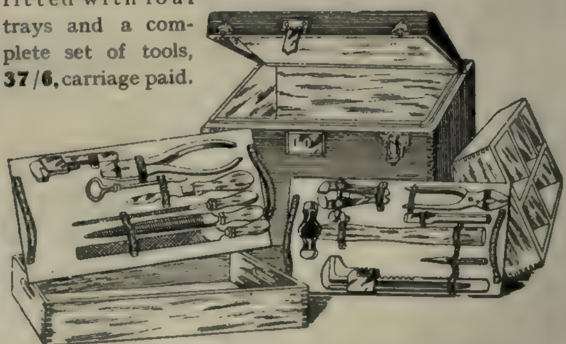
GUINEA CLEANING OUTFIT.

7 Sponges.
12 Sponge Cloths.
4 Chamois Leathers.
1 Spoke Brush.
1 Tin Metal Polish.

Mahogany-stained, brass-bound

TOOL BOX,

fitted with four trays and a complete set of tools, **37/6**, carriage paid.



STEPMAT

of the finest quality fibre—with any colour borders to match colour of car. In highly finished brass or nickel tray, **7/6.**

JOHN BARKER & Co., Ltd., High St., Kensington, W.

When it's too hot for anything let the engine do the work

The

ATLAS ENGINE-DRIVEN TYRE PUMP

saves time, tyres, and temper, and fully inflates a heavy tyre from flat in 3-4 Mins. with pure, cold, filtered air. Not petrol vapour. The first and original engine-driven tyre pump. Beware of imitations. Insist on an Atlas. Known and used all over the world with the greatest satisfaction. Thousands in daily use and giving utmost satisfaction. Read this letter:

The New "Baby" Atlas Engine-Driven Tyre Pump

[COPY.]

DAIMLER COMPANY, LIMITED,

EMCI/HK. Daimler Works, COVENTRY.

Messrs. The Atlas Inner Case Synd., Ltd.

Dear Sirs,—It may interest you to know that our Nottingham Depot advise us that they have used one of your pumps in their garage continually during the last twelve months and find that it is an exceedingly satisfactory accessory to have, saving much time and trouble in the pumping up of tyres.

Careful tests have been made from time to time in order to ascertain whether the air supplied to the tyres becomes tainted with oil or petrol, but no trace of either ingredient has been found.

Yours faithfully,

THE DAIMLER COMPANY, LIMITED.

ANOTHER item of interest is that in one year we sold £4,500 worth of Atlas Pumps to **one firm alone.**

ATLAS Engine Driven Tyre Pumps are Standardised on Lancia cars.

THERE must be a reason, and there is. Not that the Atlas is in a class by itself—a vague claim, for the number of the class might be third or fourth—but that the Atlas is first and the rest nowhere.

PRICE: Standard Model, complete with hose, pressure gauge, standard sparking plug adapter, filter attachment, etc., ready for use .. **£3 15 0**

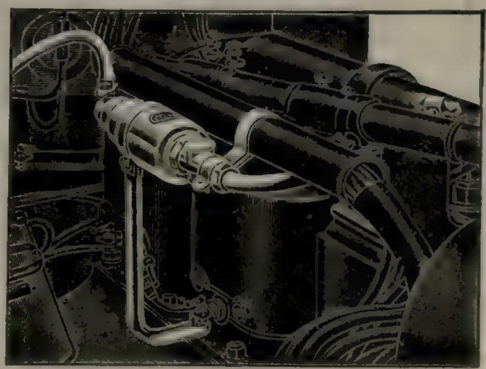
With Special Quick Detachable Plug, and adapter, as illustrated **£4 4 0**

For permanently attaching to engine .. **£4 15 0**

THE new Atlas "BABY" Pump for Light Cars, Cycle Cars, and Fords, with gauge .. **50/-**

Identical in every way with the large model, except as regards size and weight.

Showing Atlas Pump permanently fitted



Obtainable of all good Agents and Garages, or direct from the Atlas Synd., Ltd.
Wholesale Agents for France: Messrs. KIRBY BEARD & Co. Ltd., PARIS.
Wholesale Agents for Spain and Portugal Messrs. BROWN BROS., Ltd., LONDON.

THE ATLAS NON-PUNCTURE INNER CASE SYND., Ltd., 14, Woodstock St., London, W.

The Sleeping Bodied

VALVELESS

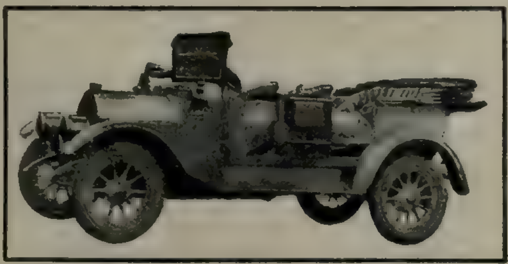
COLONIAL CAR.

THIS car has been designed and constructed especially for Colonial use. In a few minutes the body can be transformed into a comfortable sleeping saloon, whilst the waterproof hood, side curtains, and special windscreen give complete protection to the occupants, and at the same time allow ample ventilation.

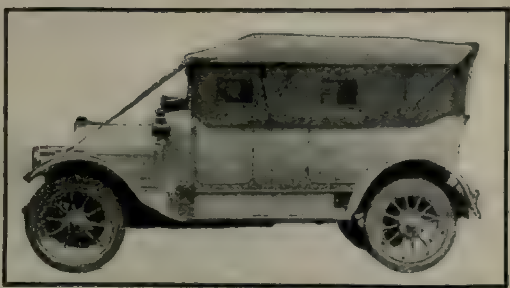
The excellence of workmanship, and the skilful manner in which space is utilised, enable these special features to be embodied without the car's outward appearance differing from that of an ordinary well-made open touring car.

The wonderful compactness of the Valveless engine has permitted the amplest space for the body, without unduly elongating the wheelbase—a very important point for a car which may be required for narrow tracks and rough roads.

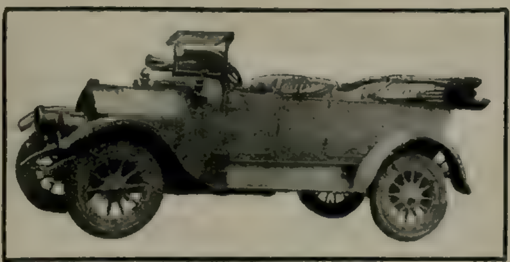
The Valveless engine has only SIX WORKING PARTS, no valves or sleeves, only one sparking plug, and nothing to adjust. This extreme simplicity gives the maximum of efficiency, reliability, and economy, whilst with ordinary care no repairs or replacements of any note will be necessary.



Showing arrangement for sleeping accommodation.



Car closed with special hood, curtains, and screen.



Car as it appears in ordinary use.

15 H.P. VALVELESS CHASSIS (Special Colonial Model), Engine fitted with water pump. Exhaust, air inlet, and magneto carried specially high up, enabling the car to ford comparatively deep rivers. 10½" clearance with 815 × 105 mm. tyres. Chassis brass finished Fitted with four-815 × 105 Dunlop plain tyres, complete tool kit, and five Shrewsbury and Challiner detachable rims 815 × 105.

Price £315.

19·9 H.P. VALVELESS CHASSIS, as above „ £335.

SPECIAL "SLEEPING" FIVE-SEATED TORPEDO BODY, painted French Grey, with Green fine lines and mouldings, best English waterproof leather upholstery. Mahogany fillets to top of doors. The back of driver's seat to fold down so arranged that the joint at rear panel is carefully concealed, the same fitting into the necessary hidden supports, making a comfortable bed for two persons, with detachable cushion and waterproof sleeping sheet. Cape cart hood with side curtains arranged so as to completely enclose the occupants at night or in bad weather, used in conjunction with special wind screen. The body mounted on the chassis complete with wings with side shields and valances, mud shields between chassis frame and running boards, two brass paraffin side lamps, one ditto tail lamp mounted on brackets. Number plates, special torpedo type horn, jack, pump, three tyre levers, oilcan, spare rim carrier with well sunk in off-side running board, spare 815 × 105 mm. Dunlop plain tyre with tube and security bolts.

Price of 15 h.p. car fitted as above .. £450 (Code word: "Morpheus.")

„ 19·9 h.p. .. „ .. „ .. £470 (Code word: "Comfy.")

Extra for: Two special 9" Mangin lens flare-front head lamps of solid brass with separate generator, fitted to nearside running board, and connected up to lamps with the necessary rubber and metal piping, including supplying and fitting two lamp irons.

£11. 11. 0. (Code word: "Lamps.")

DELIVERY of complete car about five weeks from date of receiving order.

TERMS. £100 with order, balance to be obtainable by us from a bank in London against the bank receiving advice that the car is ready for delivery.

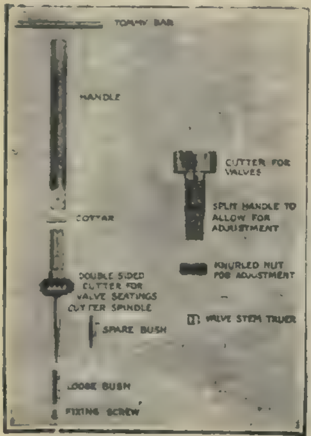
PACKING & DELIVERING F.O.B. LONDON £13. 10. 0

"THERE IS STRENGTH, SAFETY & SATISFACTION IN SIMPLICITY"

DODSON MOTORS Proprietors: DAVID BROWN & SONS (Huddersfied) LTD., **HUDDERSFIELD**

SOUTHERN AUTOMOBILES, Ltd., BLACKHEATH, LONDON, S.E.

CODES: A.B.C. 5th EDITION.



The Arrol-Johnston Specialists

AUTHORIZED AGENTS FOR ARROL-JOHNSTON CARS.

S.A. VALVE SEATERS AND TRUERS, FOR ANY MAKE OF ENGINE, FROM **40/-** PER SET COMPLETE.

S. A. STEP LIGHTS FOR AUTOMATICALLY LIGHTING THE STEPS OF CARS AT NIGHT OPERATED BY THE OPENING OF THE DOOR. **30/-** THE PAIR COMPLETE.

S.A. AUTOMATIC HEATER AND FOOT-WARMER, COMPLETE WITH FITTINGS AND CONNECTIONS, **£4.**

MANUFACTURERS OF

DUVALS PLATES FOR SPRINGS.

PORTABLE BRAZING PLANTS,

ETC

WE SPECIALIZE IN THE MANUFACTURE OF

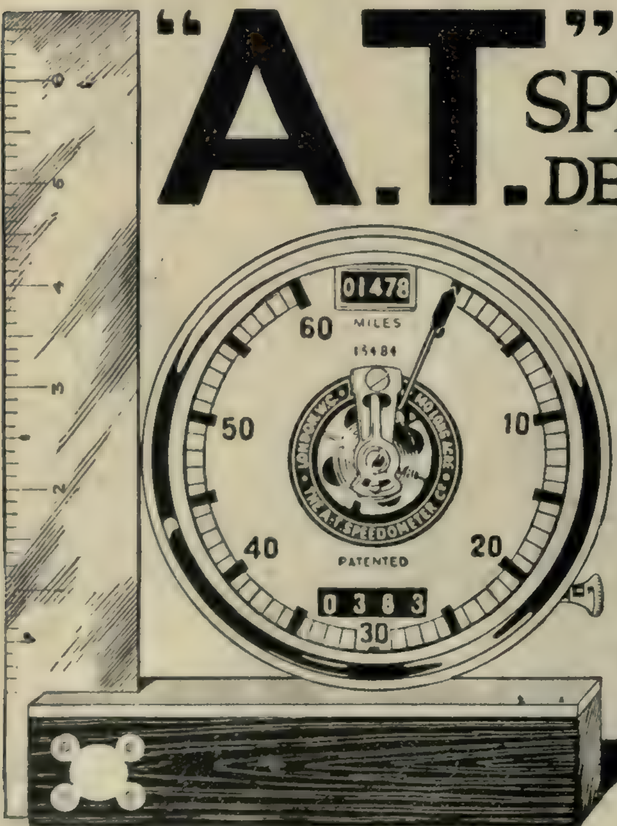
MILLING CUTTERS, REAMERS, PORTABLE ELECTRIC LAMPS,

ETC.

Telegraphic Address: "AUTOGINEER, LONDON."

"A.T." SPEEDOMETERS

DEAD ACCURATE



ANYWHERE—everywhere—hot or cold climates—rough or smooth roads—high or low speeds, the "A.T." Speedometer is always "dead accurate." The needle remains steady in spite of road shocks: the double armoured drive assures perfect transmission. The clear 4″ dial is easily read. No attention—no oiling required.

Write for the book of the "A.T."

The "A.T." Speedometer Co., Ltd.,
140, Long Acre, London, Eng.

Godbold

Austro Daimler

automobiles are representative of the highest point that has ever been attained in design, manufacture, and construction.

The organisation responsible for their production have resources at their command to the total of £5,000,000

Whilst the Austro-Daimler works have been described by engineers of International reputation as the finest they have ever seen.

This being so, it can be quite easily understood that the Austro-Daimler is admittedly, "The Car which excels."

MODELS: 16-18 h.p., 16-25 h.p., 20-30 h.p., 35-60 h.p., 27-80 h.p. all fitted with the latest ideas in coachwork.

We shall be pleased to place a demonstration car at your disposal at any time for a trial run.

AUSTRIAN-DAIMLER MOTOR Co., Ltd.,

112, GREAT PORTLAND STREET, LONDON, W.

Telephones 238 and 239 Gerrard.

16-25 h.p. "Alpine."

C.D.C.

T
Technol
A

The Autocar

IMPERIAL YEAR BOOK

1914.

FOR CIRCULATION IN THE COLONIES,
OVERSEAS DOMINIONS AND ABROAD.

PUBLISHED ANNUALLY BY—
ILIFFE & SONS LIMITED, 20, TUDOR ST., LONDON, E.C.,
ENGLAND.

PREFACE.

THE main aim of this work is to put into a convenient form, for the benefit of readers beyond the seas, a volume of information on motor subjects which will keep them up to date; in other words, the attempt is to provide a review of automobiles and automobilism as they stood at the opening of the year.

For some time past it has been felt that the need existed for such a compilation as "The Autocar Imperial Year Book," and the endeavour has been to compile a standard work of reference for the use of motorists abroad and the many intending users who desire a means of making reliable comparisons of cars and accessories before purchasing.

A glance at the contents on the next page will show the wideness and scope of the book. The effort has been to make it of use and interest, not only to those who want to know about technical aspects of the subject, but also to those who are interested in it either from a business or a recreational point of view.

The compilation has mainly been carried out by men who have personal knowledge of Britain beyond the seas. They have endeavoured to keep in mind the things which those who are separated from the motor manufacturers by long distances, and consequently long time intervals, most wish to know, and they will be grateful for any criticisms which will enable them to make future editions of the work more useful.

SECOND EDITION.

The compilers hope and believe that the 1914, or second edition of "The Autocar Imperial Year Book" will be even more useful to its readers than the first edition. No drastic alterations have been found desirable or necessary, but certain new features have been added, and the old ones revised and brought up-to-date.

CONTENTS.

(*A full index will be found at the end of the Editorial Section.*)

The Autocar IMPERIAL YEAR BOOK 1914

The Modern Chassis: Tendencies of Design.

1914 Practice and Tendencies as exemplified by the Exhibits at the last Olympia Show, together with some Criticisms.

(*Coachwork is reviewed on pages* 9-18).

Engines.—Last year in our general criticisms of the Olympia Show that had taken place in the preceding November we referred to the fact that it was somewhat strange that in the very small engines of 60 mm. bore or less there were no examples of a really long-stroke type. In the twelve months' interval the number of small engines in the Show has increased, but the majority of them are still of a relatively short stroke, the longest stroke, indeed, in relation to bore being the 60 × 120 mm. combination as exemplified by the Bayard and the Hillman, neither of which has made any attempt to keep its engines within the 1,100 c.c. limit, as both are over 1,300 c.c. Another class of small engine of quite different proportions, but of about 1,300 c.c., is found in the 65 × 98 mm. Adler and the Opel of the same dimensions. On the other hand, those small engines which come within this 1,100 limit are, again generalising, of approximately 60 × 90 mm., such as the Morris-Oxford 60 × 90 mm., the Calthorpe 62 × 90 mm., and the Standard of the same dimensions. The Baby Peugeot still remains the smallest four-cylinder engine in the exhibition, as was the case last year, its dimensions being 55 × 90 mm., giving a capacity of only 856 c.c. This was shown in 1912, but, strangely enough, more than one of the small-engined cars which were shown last year at Olympia, and were also actually on the market, were believed by many to be making their first public appearance at the last Show, and were treated as utter novelties. As to the engine of about 65 × 120 mm., or say of 1,600 to 1,700 c.c., this has been with us far longer, and has long since lost any flavour of novelty, as with a chassis and a load proportionate to its power it has done excellent service, and has established a definite position for itself.

With larger engines, it cannot be said that the tendency towards long strokes has grown stronger, the longest stroke in relation to bore still remaining in the 80 × 180 mm. Hispano-Suiza, though in this respect the two new models of this particular make actually show a reduction in stroke-bore ratio, one being 90 × 150 mm. and the other 100 × 180 mm. However, when a comparison of the 80 mm. engine of to-day is made with that of two or three years ago, there is no question that the average shows a longer stroke. Many firms who were then content with 80 × 120 mm. have now gone up to 80 × 140 mm. and 80 × 150 mm., the leaders in this respect undoubtedly having been the Sunbeam; we do not mean that these cars were the first to possess such dimensions, but they were certainly the first to demonstrate unmistakably their efficiency in competition and to popularise them commercially immediately afterward—and 150 mm. still remains the longest stroke used in conjunction with an 80 mm. bore by British designers. Speaking quite broadly, engine design lends support to the very old assertion that the right policy in designing a series of engines of varying power is to select a given stroke and then to vary the powers by varying the bores. At the time this was enunciated, 130 mm. was regarded as the longest desirable stroke, and while this still remains at or near the maximum believed in by many designers, a new school has grown up which advocates 150 mm. or thereabouts as the maximum stroke desirable. Although the advocates of the 130 mm. as a maximum stroke are holding their own, there is no denying the fact that 150 mm. is no longer regarded as a really long stroke.

Nowadays much more is expected of an engine than used to be the case, quite heavy loads being laid upon comparatively small engines as shown by the tendency to lengthen wheelbase and lower gears, which we refer to further on in this article. This does not mean that cars are driven more slowly than of yore, but rather that the engines have to run at much higher speeds. Nevertheless, great as is the improvement which has been made in the running and balancing of engines, the fact still remains that a fairly large engine which is never called upon to run very fast is still the pleasantest to drive.

The Modern Chassis: Tendencies of Design.

Cylinders.—The *monobloc* engine becomes more widely used each year, and it is now quite common for really large engines, and firms who at one time would have nothing to do with the *monobloc* casting are now employing it; still, a very large number continue to adhere to casting their cylinders in pairs, and two well-known makes, the Austin and the Cadillac, adhere to their long established practice of casting each cylinder singly. Personally, we do not regard it as an important point whether the engine be cast singly or quadruply so long as it is a good engine. This applies to cars for home use; when it comes to cars built for use abroad in parts of the world where repairers and repair shops are few and very far between, it seems to us that the pair-cast or single-cast cylinders must be preferable unless the engine is a small one. So far as six-cylinder engines are concerned, the Rolls-Royce practice of casting them in two groups of three has been very widely followed, though more than one maker of small six-cylinder engines is actually casting them in a single block. Last year we had to comment upon the disappointing fact that, with the exception of the Standard engine, and one or two others, no serious attempt had been made to facilitate the cleaning of the top of the piston and the combustion head; we are sorry to say that this criticism holds good to-day.

Number of Cylinders.—So far as Olympia is concerned, the single-cylinder engine is practically extinct, and the two-cylinder is also decreasing in vogue; for such successful makers of the two-cylinder engine as De Dion and Swift are now turning out small four-cylinder engines of approximately the same power as the twins hitherto associated with their small car activities. There seems little doubt that till the two-stroke engine becomes a thing of general use instead of a rarity, the four-cylinder engine will be employed for all but the very smallest and simplest of cars. Nevertheless, there is a strong feeling that the small four-cylinder car is rather too complex for a good many of the users for whom it is intended, and it seems quite possible that this feeling will give rise to concerted rather than sporadic efforts to bring the two-stroke engine to such a stage of development that it can be confidently recommended; indeed, the success of the Valveless car has already shown that this is not an impossible feat, while the applicability of the two-stroke engine to small sizes has certainly been very emphatically demonstrated by the two-stroke engine on the Scott motor bicycle. Undoubtedly, a light car fitted with a good two-cylinder two-stroke engine giving the same number of impulses per revolution as a four-cylinder engine would be exceedingly popular on account of its great simplicity.

Although the six-cylinder engine is no longer regarded as the sole prerogative of the high-powered car, there has been no tendency to follow the Delage example at all widely. It was anticipated by more than one student of automobile design that the example set by the Delage of making a 65×130 mm. six-cylinder engine would be followed by quite a number of other makers; up to now the only firm to do this is the Hillman, who exhibited the smaller six-cylinder model in Olympia, 60×120 mm. In a size larger the Talbot 80×120 mm. six-cylinder engine, which is now quite an old-established model, has been very successful, but again, strangely enough, it has not been copied. Of course, the great points in favour of the six-cylinder engine are its excellent torque and nearly perfect running balance, the latter being particularly important in these days of comparatively low gears, and it is for this reason that we believe in the near future there will be other examples in addition to the few existing to-day of the quite moderate and even the very small powered six-cylinder engine, simply and solely because modern conditions necessitate high engine speeds, and a properly built six-cylinder engine is so much smoother under these conditions than a four-cylinder. On the other hand, under the heading of Change-speed Gears and Final Drives we shall refer to the Cadillac development, which, if followed at all widely, will undoubtedly deter any immediate increase in the number of medium and small powered six-cylinder engines, because to a very large extent it will banish the necessity for high engine speeds.

Poppet Valves.—The poppet valve is still the valve of the day by a tremendous majority. The design and manufacture of poppet valve gear as a whole had reached such an extreme stage of refinement, thanks in the first place to the silent-running steam car, and in the second to the Knight sleeve valve engine, that it is hardly to be expected that any notable development should have been made since our review of a year ago. Nevertheless, there is still a good bit to be done in the improvement of poppet valves: when they leave the factory they are quiet enough, but few of them keep as quiet as they might do for long periods of running. Perhaps the most aggravating feature about the poppet valve gear of to-day is the fact that it is not only difficult but impossible to adjust the majority of engines so that there shall be no audible tapping of one or more valves when the engine is running slowly; it does not matter how carefully the clearance between the tappets and the valves may be adjusted: it is often found impossible to stop at least one of them from tapping aggravatingly. Although this is not past remedy, it is not a mere matter of adjustment, but is generally due to wear on the bearing of the roller at the bottom of the tappet, or in a few cases to wear on the tappet guide itself. In connection with tappets we are glad to see that the practice of inserting fibre buffers inside the tappet heads is dropping out. Of course, the idea of this was to deaden noise, and it was successful while the engine was new, but the comparatively soft fibre very soon compressed lower than the head of the tappet, so that the valve could never be adjusted by gauge, as it was, obviously, useless to insert a feeler between the valve and the tappet when, as a matter of fact, the tappet had a hole in it.

Another tendency is to eliminate the tappet springs. We are not now referring to the valve springs, but to those which were supposed to keep the tappets quiet. These, again, do not appear to have had any direct bearing on noise, and have, consequently, been dropped in a number of instances.

We do not remember any car other than the Sheffield-Simplex which has special provision for preventing air leakage up the valve guides so that carburation may not be upset in slow running after an engine has been in use for a long period, but, provided the guides are really long, we are not sure that very much can be done in the way of a stuffing box which will not introduce extra friction, and, in any case, it is a complication which can hardly be regarded as being justified in cars in which continued silence of operation is not the first, or one of the first, considerations of the designer. Another refinement of the same makers is the lining of the detachable valve covers with felt. This is certainly not a complication, and must all tend towards the deadening of noise.

Strangely enough, no maker has yet followed marine practice of putting the whole of the valve gear inside the crank chamber. This lubricates every part, including the valve guides, and the one real objection to it is the fact that to get at the valves necessitates the breaking of large joints, which, of course, would be most troublesome if not oil-proof. Still, there are no insuperable difficulties to be overcome, and we rather wonder that the attempt has not been made in more than one instance, *i.e.*, the Bianchi. On the other hand, quite a number of makers arrange for the oil to come up the tappet guides and even to overflow and return to the crank chamber, notably the Panhard, and a somewhat similar principle is carried out on the Star.

Again, it is somewhat strange with the growing use of the chain drive for the camshaft that the T-headed engine has not returned to wider use, because it is easier to provide good large valves with this type of engine than with the Γ-headed engine, and these valves can be really well water-jacketed. Moreover, when the engine gets dirty it is much more easily cleaned.

Non-poppet Valves.—Both the Knight two-sleeve and the Argyll single-sleeve have more than held their own, and in the case of the two-sleeve combination more than one new adherent has appeared since last year, but we believe the Daimler and the Siddeley-Deasy remain the only two manufacturers who turn out no poppet model of any sort, but pin their faith absolutely to the twin-sleeve valve.

The Itala rotary valve is now well established, as it is two years since it made its first appearance in this country then as a feature of one model only; now it is standardised for three.

The newcomer so far as the Olympia is concerned is the Maudslay-Reno engine, which we described as being of the cuff type, though the makers have very properly decided to call it a slide valve engine, as that is what in engineering parlance it really is. It will be recalled that it has a short sleeve working above the piston, covering and uncovering the ports in proper sequence.

A good many keen students of design tendencies are firmly of the opinion that the final valve gear which shall combine the virtues of both the poppet and sleeve types without any of their drawbacks will be either of the rotary or the short slide valve patterns. It is never safe to prophesy in these matters, because such prophecies can only be based on current practice, *i.e.*, on what the prophet knows at the moment, but if rein be given to the imagination it is, probably, almost as safe to prophesy that valve gear as we know it to-day will be entirely abolished by the advent of the nearly perfect two-stroke engine.

Valve Drives.—The driving of the valveshaft by chain is coming into still wider use, though it is far from general practice. Undoubtedly the credit for the introduction of the chain drive in its modern form goes to the Daimler. The driving of the valveshaft by means of chains is older than the motor industry, but the chains formerly employed were not of the modern silent pitchless variety, but very much cruder things altogether, and not really fit for the work. Nevertheless, not a few of the very best makers in the world disbelieve in and will not employ the chain drive, though it is equally true that at least as many of equally high reputation use it and do not do so from considerations of economy. The great attraction about the chain drive from the owner's point of view is that it is quiet. Only the very best spur gears are as free from noise, and they are only made to reach this stage by a great deal of painstaking on the part of the manufacturers. What is more, the quietness of the chain is not impaired by adjustment of the crankshaft bearings after long periods of running, and there is no getting away from the fact that when the time comes for renewing the distribution drive it is much easier to fit a new chain and chain wheels which will run quietly than it is to fit a new set of spur gears which will be quiet. The job of fitting the gears is easy enough, but to get them to run quietly is quite another matter. It is still a fact that a very large number of chain drives have no means of adjustment. The chains are "run in" on dummy wheels, and the first stretch is taken out of them before they are fitted, and after that nothing can be done to them; when they wear seriously they must be scrapped and replaced by new ones. On the other hand in many cases where adjustment is provided it is of an extremely ingenious and simple nature, and not only makes provision for taking up chain slackness, but also for rectifying the timing of the valves, which, of course, is slightly upset after the chain has worn considerably. There are really two schools of thought in this matter. The one maintains that when a chain has worn sufficiently to require adjustment it is time to scrap it, and the other that even if this be true the adjustments are most useful in building the engine, as they enable the assembler to start with his chain tension just right. However this may be, there is no getting away from the fact that on a good many of the cars which have no means of adjustment many of the chains are really too tight when first fitted.

Camshafts and Bearings.—One of the simplest truths in connection with engine design has been a long time in being recognised, but once recognised it has certainly been widely adopted. We refer to the fact that so long as a crankshaft is really stiff and well supported all the worst of the troubles in connection with periodicity and harsh running are overcome. This simply means that appreciable whip of the crankshaft, which is the primary cause of harsh running, does not occur if the crankshaft be of really adequate dimensions. The limits in the stiffening of crankshafts appear to have been reached, and now only the out-of-date engines are provided with shafts of insufficient size. On the other hand, some who have stiffened their shafts have not yet realised that this is only one link in the chain, and that a stiff shaft is of little good unless the bearings themselves are adequate, and the crank chamber be strengthened proportionately with the crankshaft. That is to say, the shaft must be adequately supported. A good many designs still leave something to be desired in this direction. Incidentally, the *monobloc* engine has assisted in securing freedom from distortion of the crank case, as it undoubtedly does assist very materially in acting as a sort of bridge or girder. No universality of practice exists so far as the number of bearings is concerned. Many designers pin their faith to five for a four-cylinder engine, and seven for a six, but recent investigation into the behaviour of crankshafts by means of rotating balancers, such as the Norton, of Messrs. Alfred Herbert, Ltd., as well as mathematical calculations, show that an adequate central bearing in addition to a really good bearing at each end is better than the larger number of smaller supports. This brings up the fact that, so far as we could gather, no one engine in Olympia had a counterbalanced crankshaft, that is to say, each crank pin is not individually balanced by extensions of its crank cheeks, but is balanced by the next crank pin to it.

so that there is, as it were, a tilting balance which imposes considerable unnecessary loads upon the central or intermediate bearings. Probably the reason for the absence of the counter-weighted crankshaft is the difficulty connected with its manufacture, but the advantages in favour of it appear to be very real, and we should imagine that these difficulties are not insuperable. They certainly should not weigh with manufacturers of the highest class of engine, and in these days of high engine speeds anything which will conduce to smoothness of running and reduction of wear cannot be safely ignored.

The steel piston is making steady headway, though for a long while its introducers as a matter of everyday fitting on standard cars—the Lanchester—stood alone. Now, however, several firms fit them as a standard, but they are very much in the minority. On the other hand, the advantages of a light piston are being much more generally recognised, and although cast iron pistons are still used in the vast majority of engines, they are very much lighter than of yore, and great pains are taken both in the selection of material and in the methods of machining, which have tended to reduce weight without sacrificing necessary strength. From a racing point of view, the advantages of a light piston and connecting rod have never been disputed, but what has not been widely recognised by manufacturers till comparatively recently is that, at any rate so far as the smaller engines are concerned, high piston speeds are common, as the engine only gets its power by low gearing and consequent high revolution speeds, so that plenty of standard engines run to-day at what were regarded as racing speeds only a few years ago. Again, not only is a very lively engine obtained when the reciprocating parts are light, but the bearings are greatly relieved by saving them from the needless work they are called upon to perform in holding a heavy connecting rod and piston to the crankshaft. After all, it is the bearings which keep the connecting rod and piston from being flung away, and it is obvious that their tendency to fly off is very great at high engine speeds, and it therefore follows that the heavier the reciprocating parts are, the greater is the restraining influence which the bearings have to exert. Reciprocation necessitates starting and stopping, and the effect of doing this many times a minute can be gauged by trying to imitate a piston by holding a pound weight in the hand and moving it up and down quickly and then repeating the performance with a two pound weight. This shows what the reciprocation of needless weight means even at slow speeds. This is only a very crude way of putting the case, and it only deals with one aspect of it, but it is sufficient to make it clear to the untechnical why the advocates of light reciprocating parts are not mere visionaries or racing enthusiasts. In regard to keeping oil from getting above the pistons and thereby quickly dirtying the engine, no one seems to have followed the Talbot practice introduced last year of fitting all the piston rings below the gudgeon pin. We understand this practice has been entirely successful, as it has had a marked effect in keeping the engine clean and has been accompanied by no drawbacks.

Engine Lubrication.—The prevalent system is still the trough or regulated splash, the oil being fed by a gear wheel pump to a trough under each big end, which dips into it every time it comes round, the rest of the engine depending for its lubrication upon splash from the big ends. There are variations from this system, as in some cases little cups are formed above the main bearings and oil is poured into them as well as into the big end troughs. In others catch pits over the main bearings are provided, but they are filled by the general downpour of oil mist which obtains so long as the engine is running. In the Daimler engines the big end troughs are inter-connected with the throttle, and are raised slightly nearer the big ends as the throttle is opened, so that whenever the engine is working hard—that is, on a wide throttle—the dippers on the big ends go deeper into the oil and splash more of it about the engine. Internal lubrication, although not ousting the trough from its position of being used on the larger number of cars, is undoubtedly gaining ground. There are several instances this year of firms which hitherto used trough lubrication now adopting the internal system in which the oil is forced through a hollow crankshaft to the main bearings and to the crank pins, only the gudgeon pins and the camshaft bearings depending on splash, though in many cases provision is made for what we may describe as encouraging the splash to run towards the camshaft bearings, and in quite a number of systems a little separate oil pipe is provided to lubricate the distribution gear whether it be by chain or spur gearing. Absolutely complete internal lubrication—that is forced lubrication right up to the gudgeon pins—is only used in a few cases. The fact that gudgeon pins will run successfully, and do so run in the majority of engines, with nothing but splash from the bottom bearings, always seems rather remarkable at first sight, but it is not really extraordinary when one considers the tremendous slinging powers of a revolving crankshaft. Nevertheless there is no doubt that the lubrication is better if internally forced, but a good compromise is effected when by means of a hollow gudgeon pin or some similar provision oil from the cylinder walls is introduced internally and the bearing does not have to depend entirely on what may get into it from splashing. This arrangement does not add to the reciprocating weight as does the hollow rod pressure system or that in which an outside lubricating pipe is fitted.

The use of comparatively small filters upon which the pump draws is gradually dying out in favour of a really large filtering gauze beneath the crankshaft, which may be described as a gauze false bottom between the crank chamber proper and the oil sump. This means that all the oil that has passed through the engine as it goes back to the sump passes through the gauze which has so large an area that the engine can be run for very long distances indeed before there is the smallest fear of the gauze becoming blocked. With the small filters the filtering area through which the whole of the oil has to pass is so small that if cleaning be neglected they may become blocked up and thus greatly impede the oil circulation, but with the very large area provided by the gauze false bottom this possibility is postponed for an almost indefinite period. Provision for draining out the crank chamber is in most cases inadequate, though it would be very simple indeed to make it an easy job. It is a pity that the Vauxhall plan of a mud trap has not been more widely followed. With this simple device it is possible in a few moments to let out from the mud trap the cupful or so of dirty oil which, by the shaping of the sump, will always accumulate in the trap. When this trap is opened a spring valve drops and seals the sump so that no oil is lost other than the small quantity in the trap. With most engines this sediment can only be removed by draining off all the oil in the engine.

Ignition.—Beyond recording the fact that magneto ignition remains practically universal, there is nothing

particular to be said on this subject. On the other hand, there is a vast difference in the accessibility of the magneto on various engines. While this machine requires very little attention, the distributer must have occasional cleaning, and from time to time the make and break must be looked to, and on some engines this is almost an impossibility. This would not really matter very much if the magneto could be readily removed and replaced without much risk of mistake, but in many instances the couplings are of a nature which, if once disturbed, mean very great trouble in replacement and so great a risk of upsetting the timing that there is every encouragement to neglect the very occasional attention which the magneto requires. There is a very general tendency of the design to drive the magneto by means of a cross shaft in front of the engine, at one end of which is the magneto and at the other the pump. It certainly provides a most accessible magneto, but needs carrying out very carefully if the engine is not to be unduly widened. On the other hand, the advent of the lighting dynamo has given rise to quite a number of designs in which one long shaft usually chain-driven runs along the blind side of the engine, driving the pump, the lighting dynamo, and the magneto. At first sight this rather appeals to one's sense of utility, but we are by no means certain that it is a desirable plan, because it means that the dynamo must be run continuously whether required or not, and also that should anything go wrong with it of such a nature that it must be removed, the car is out of action till the dynamo can be re-adjusted or repaired and replaced. It therefore appears that it would do better if the dynamo were indirectly driven from this shaft. This would not only enable it to be removed without affecting the utility of the rest of the car, but it would be so easy to make arrangements for the dynamo to remain idle when not required for charging purposes.

Carburetters.—Apart from the fact that there are almost as many various forms of carburetters as there are makes of motor cars, the most noticeable feature in connection with carburetters is the widely differing arrangement of this very important accessory. We are glad to note that there is a real tendency towards simplification, but many are still to be found which are an absolute nuisance to the owner if he should have to keep his car in a cold motor house or shed in frosty weather, as their water jackets can only be drained by the disturbing of one or more small copper pipes, and the breaking of their water joints. These pipes are very delicate, and the chances are that if they are undone the pipe will twist through sticking to the nut. On the other hand, if they are not drained they freeze up in the night, and then when the engine is started the carburetter jacket commences to leak. We are, therefore, glad to see that the Rover and the Hotchkiss plan of bolting the carburetter straight on to the cylinder jacket is being followed by other makers. With this arrangement when the cylinder jackets are drained of water the water also comes out of the carburetter jacket, and there is no needless trouble or anxiety. Many of the jets are still needlessly inaccessible, so that if they should block at any time it takes a long while to get the jet out and to put it back. In some cases this is not the fault of the carburetter, but rather of its position, and now that pressure feed is so general it seems a pity that the carburetter should not be carried higher up in those cases where the jet can only be taken out from underneath the carburetter. It is obvious that directly pressure is depended upon for supplying petrol to the float, there is no objection to fitting the carburetter in a high and accessible position. To return to the question of water warming the carburetter, this is now practically abolished on some designs by the simple fact that the carburetter is practically a part of the engine itself, being bolted straight against the engine on the opposite side to the valves, and the induction passage between the cylinders naturally becomes so warm that there is no need for jacketing the mixture chamber, as it very soon reaches the temperature of the engine itself. This certainly seems to be a step in the right direction.

Engine Cooling.—One of the subjects which has been more prominently before motorists this year than formerly is engine cooling, owing to the fact that so many motorists who have toured in the mountainous parts of Europe have had trouble from the water boiling away so rapidly that they have been unable to climb quite moderate passes like the Mont Cenis without several stops for fresh water. There were two instances at least in the Show of simple devices which appear likely to overcome this trouble entirely. The first is on the Sheffield-Simplex chassis. This engine normally depends upon thermo-syphon cooling, and under all ordinary conditions runs quite well by natural circulation alone. At the same time it is not overcooled to such an extent that it could be taken to the Alps without boiling in really hot weather. It will be remembered by students of the Sheffield-Simplex engine that last year by the side of the magneto-shaft was another one which drove the lighting dynamo. This dynamo is no longer required, as its place has been taken by the dynamotor which replaces the flywheel, and which performs the offices of charging dynamo or engine starter as required. Therefore on this otherwise redundant shaft a pump has now been fitted which can be thrown into or out of gear as required. This pump sucks from and delivers into the bottom water pipe in the direction of the water flow, and may be described as a circulation accelerator. It can be thrown into or out of action as required by a small lever. The other solution of the difficulty is on the new big Hispano-Suiza, and is substantially the same, but instead of by a dog clutch the pump is thrown in or out by a friction clutch of the single plate variety, but the basic principle of working does not differ from that of the Sheffield-Simplex.

Engine Accessibility.—Nothing was more striking than the wide differences in accessibility exemplified by the cars at the Show. We find one engine with its eight or twelve valves, as the case may be, and absolutely nothing else on that side of the engine, and after removal of the valve covers every one of the valves can be got at with equal ease. On the other side the carburetter is found high up, and easily got at, while the magneto is either carried on a cross-shaft in front of the engine, and quite accessible, or it is placed by the side of the engine, low down in what is really a very inaccessible position, but this objection is entirely overcome by the fact that the coupling is of such a nature that the magneto can be almost instantly lifted out of the engine and attended to on the bench. Side by side with this we find engines in which all the valves, the carburetter, the inlet pipe, and, of course, the exhaust branch, are all in one more or less hopeless conglomeration, so that the mere adjustment of a valve tappet is a matter of the extremest difficulty, while the taking out of a valve is almost out of the question unless one first removes the carburetter and the induction pipe at least. The reason why we advocate the magneto

being carried low down by the side of the engine, if it is not placed across the front, is that it is then out of the way of the valves when they require attention, as, even if it be placed fairly high, it is still not accessible, but it gets in the way when one wishes to see to the valves. Again, we often find that the oil filler is placed somewhere in the middle of the engine on the valve side, so that it makes it more or less difficult to approach one or more of the valve tappets. Last, but not least, scarcely one maker in ten ever provides a valve removing tool in his outfit.

Another thing bearing on engine accessibility is the undershield. There is really no need for this if the engine be properly designed. In a good many cars now the crank case is extended to fill in the space between it and the main frame, so that the undershield does not begin till the flywheel. The engine undershield is a great nuisance, and appears to be mainly contrived for catching and hiding nuts or spanners which may slip through the fingers. In nine cases out of ten, too, it renders it a matter of extreme difficulty to drain the oil from the engine, and in the worst instances this oil actually drains into the undershield and makes an indescribable mess. Also, it keeps the engine needlessly warm, though we may find the designer of the car on the next stand is doing his best to keep his oil cool, not only by abolishing the needless undershield, but by casting cooling ribs on his oil sump.

Engine Starters.—Engine starters were greatly in evidence, the electrical form being very much in the majority, and the three prominent exponents of the compressed air starter were the S.C.A.T., Wolseley, and Sunbeam. Probably, had it not been for the wide adoption of electric lighting, the compressed air starter would be much more in vogue than is the case, but, having once adopted the heavy battery of accumulators, the attractions of the electric starter are difficult to resist. It is not our intention at the moment to discuss the merits of the various forms of starters: it will suffice to say that the atmospheric fall broadly into two classes, the S.C.A.T. and Wolseley types, requiring a special distributer with separate piping to the engine, and the Sunbeam, while not requiring these things, replaces them by a little air-driven engine which acts as the starting engine for the motor proper. The Sunbeam is the heavier arrangement, but it has the advantage that it will start the engine in any position.

Again generalising, the electric starters fall into two main classes: one in which the charging dynamo and the electric starting motor are separate machines and another in which a combination machine performs the double duty at will, either charging accumulators or starting the engine, and is known as a dynamotor, its name well signifying its dual purpose.

On the whole, the most startling departure from standard is in the dynamotor of the Sheffield-Simplex, which takes the place of the flywheel, and which, therefore, adds little or nothing to the total weight of the car, as the extra weight of the dynamotor is counter-balanced by the fact that the flywheel is removed altogether.

There is no settled practice yet with regard to the method of driving the charging dynamo. Provision more or less adequate is, however, made for it in a number of chassis this year, but it is only on a few in which the drive is really satisfactorily arranged—that is to say, in which the essentials of an accessible and sheltered position are found for the dynamo and arrangements made so that it need not be revolving the whole of the time the car is in use, but only at such times as it is actually required for charging purposes.

Clutches.—The cone clutch, most often leather lined, but occasionally lined with Ferodo, Thermoid, or Raybestos, is still in the majority, but the single plate clutch and the multi-disc clutch are both well represented, and, undoubtedly, the single-plate clutch is steadily gaining ground, for the simple reason that the doubly-gripped plate, which is on the clutchshaft, can be made so light that the difficulties of gear changing are greatly reduced. This is obvious when the revolving weight of even the lightest cone clutch is compared with that of a single-plate clutch; indeed, it is possible to make the single-plate so light that, when starting the car, the clutchshaft stops too soon. Another advantage of the single-plate clutch is that it requires no more attention than the leather-lined cone.

The Austin practice of putting the leather or other lining upon the flywheel in easily removable segments in place of in one strip of leather on the male member of the clutch is good, in so far as it reduces revolving weight on the clutchshaft and makes it easy to renew the leather. At the same time, it is a method of construction which requires carrying out very nicely, because the idea that here and there a worn segment of leather can be removed and replaced by a new one is not always borne out in practice, as the new segment naturally stands proud of the others which have been used.

The Vauxhall practice of running their multi-disc clutch dry, and lubricated only by flake graphite, was introduced two years ago, and it has been so satisfactory that it is being continued. Nevertheless, scarcely anyone has copied it, which seems strange, as it requires practically no attention, whereas the wet multi-disc clutch must be lubricated with the proper oil, which is suitable for no other part of the car, and this oil must be drained off, the clutch washed out with paraffin, and fresh oil put in periodically, if the clutch is to give good service.

Another rather remarkable thing is the fact that not only do the firms who have been using outside clutch springs continue the unmechanical practice, but they have actually been copied by one or two other makers. This means that the thrust of the spring is continually on the crankshaft bearings, instead of being self-contained within the clutch and only creating friction during the periods the clutch is actually out of engagement.

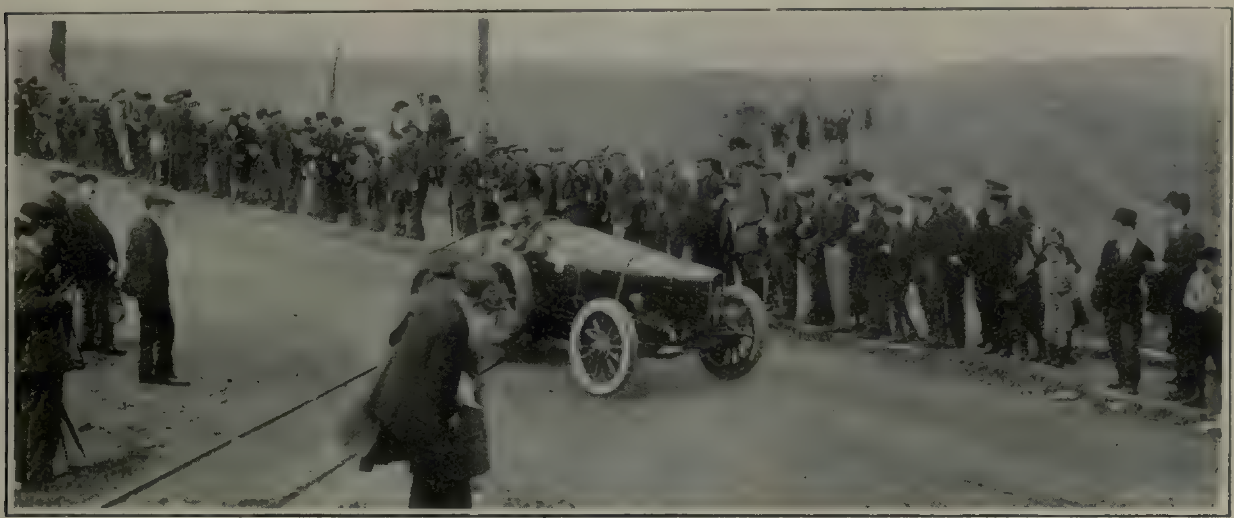
Going by what one saw at Olympia in November, 1913, many makers still fail to realise the fact that, other things being equal, the best clutch is the one which necessitates the smallest spinning weight on the clutchshaft when the clutch is withdrawn. It is these variations in weight which mainly cause the tremendous differences one finds in gear changing: cars with the light clutches are usually easy to change, while those with the heavy ones require double clutching, and extreme care and good judgment at that, if quiet and harmless changes are to be made.

Change-speed Gears.—Four speeds are becoming more and more generally employed, and, as we have steadily advocated their use for years, even at a time when such advocacy seemed almost hopeless, we will not enlarge upon the subject now, but merely content ourselves by recording a fact.

No important innovations have been made in connection with change-speed gears generally, with one

exception, which we deal with under the heading of "Final Drives." One or two makers are attempting to cool the box by providing cooling flanges or ribs, and others to improve lubrication by constructing little ducts in the walls, which carry lubricant to the bearings.

While the sliding gear remains as the conventional type, the improvement which everyone looks for and hopes for is some method which will make gear changing noiseless and harmless, so that real skill and judgment are not required when changing up or down when the engine is revolving fast and pulling hard. Taking the system with all its imperfections—we had almost said unavoidable imperfections—there is no excuse for failure to provide an easily and quickly removable inspection door which does not necessitate the undoing of four to a dozen or more nuts; it is also no excuse for the failure to provide an oil filler which shall also serve as an oil level, so that the box cannot be overfilled. Yet both these simple and desirable provisions are rare. Then, again, a gear box which does not exude lubricant is also more or less of a rarity; some of this leakage could be stopped by the provision, for instance, of an air vent, but this, again, is hardly ever provided.



The Coupe de l'Auto, September, 1913. Chassagne at speed on Sunbeam IV. For results see page 101.

The Bentall and Bianchi plan of carrying the gear box upon the front end of the propeller-shaft casing, and adopted by the Sheffield-Simplex, has been followed by the Siddeley-Deasy in one model. There are variations in the method, but the principle is the same, and there is not a little to recommend it, as it means that the mechanism is more or less reduced to two main elements: one the engine and the other the long ⊣ construction which contains the whole of the transmission mechanism with the exception of the clutch and clutchshaft. That is, the back axle, propeller-shaft, and gear box are practically a single unit. Another advantage of the gear box in this position is that it increases the unsprung weight by very little, and at the same time it tends to deaden noise, as the box is less directly connected to the main frame of the car.

Final Drives.—The consideration of gear box position, just referred to, brings us to the revival of the old idea of the two direct top drives, each equally noiseless and equally efficient, introduced on the 1914 Cadillac cars. We may perhaps remind our readers that in the Cadillac arrangement there are two concentric bevels, one giving a high top speed and the other a low top speed, and the change from one to the other being performed by the mere depressing of the clutch pedal and the touching of a switch: electricity does the rest. We cannot help thinking that this practice, though possibly without the electrical change, will come into wider use, because it has so many advantages: on the low top speed town driving can be performed as well as most main road hills ascended without changing gear, while the high top speed enables a good pace to be accomplished on the level or on slightly falling gradients without any necessity for a high rate of engine revolution, so that the car is altogether pleasanter to handle, and one obtains the advantages of a low top speed and a high top speed both equally quiet and equally efficient.

Neither the worm nor the bevel final drive appears likely to oust the other. Although the bevel is used in the larger number of cases, nevertheless the worm has quite held its own since last year and has obtained a few new adherents. Now that both are equally quiet in the better class of cars it is a matter of little moment to the owner which he selects. There is no doubt that the worm has had an extraordinarily quietening effect on the bevel, as the almost complete silence of the worm has made it necessary for the manufacturers who stick to the bevel to adopt new methods, which have enabled them to make it as quiet.

The overhead worm appears to be coming into wider use, as the difficulties prophesied years ago in connection with its lubrication do not appear to exist in practice. The objection to it is that it is difficult to design it and the chassis as a whole so that the propeller-shaft shall lie horizontally when the body is loaded. However, one or two makers have adopted the same plan as those who employ the under worm. For the under worm the engine and gear box are tilted backward, so that the wormshaft and the crankshaft are practically in a straight line when the weight is on the car; those who use the overhead worm are tilting their engine forward to obtain the same results, but, unless this is done, the angularity of the propeller-shaft is a serious matter, as it puts very heavy work indeed upon the universal joints, which not only tends to wear them out more or less rapidly, but also results in a waste of power.

The Modern Chassis: Tendencies of Design.

In one respect the worm-driven axle is in advance of the average bevel. Nearly all the worm axles have a combined filler and oil level, but a great many of the bevel-driven axles are not so provided, and proper lubrication is rendered a matter of extreme difficulty, as it is almost impossible to avoid either under or over-lubrication on quite a number of bevel-driven cars.

Universal Joints.—The most noticeable general tendency in connection with universal joints is to dispense more or less with what we may call the mechanical form, and to replace it by a flexible joint like the leather coupling used for driving the magneto on so many cars. While leather is used in some cases, in others thin steel discs or flat rings are used, but the principle is the same in each case. These joints are usually confined to the clutchshaft, so as to provide a flexible connection between the engine and gearshaft, and, of course, only a small degree of flexibility is necessary. However, examples going further than this may be cited in the Isotta-Fraschini and the Panhard, leather in one case and rubber in another forming the flexible medium between the driving and driven members. So far as the mechanical joints are concerned, many of them still leave much to be desired in regard to ease of lubrication, and none is designed to compensate for wear.

Torque and Radius Rods.—Without taking a census of the cars at the Show, we must say that the impression given is that the tendency to abolish torque and radius rods altogether has stopped. In any case, more than one firm who have not hitherto employed the propeller-shaft casing and torque tube combined have now adopted it, and the spherical head to the torque tube seems to be coming into wider use than the forked double-hinged anchorage to the main cross bridge of the frame. Nevertheless the number of important firms who depend upon the springs to perform the triple duty of springs, radius rods, and torque rods is large, and whatever arguments may be introduced to the contrary they are always able to fall back upon the practice of the London General Omnibus Co., as on these hard-worked vehicles no torque or radius members are employed, the springs performing the whole of the work. At the other end of the scale we have very successful and widely used cars of moderate power and weight constructed on the same lines.

Steering.—We are glad to note another adherent to the worm and nut type of steering besides Rolls-Royce. This is found on the new Sizaire-Berwick. In detail it differs from the Rolls-Royce, but the principle of using the nut and worm instead of the worm and sector is employed, and there are also means of adjustment provided, as in the case of the Rolls-Royce. We cannot help thinking that the worm and nut combination is to be preferred to the worm and sector or the worm and wheel for the simple reason that with the worm and nut the area of the surfaces engaged is much greater, as with the worm and wheel only a small portion of each is in use at any one time. In both types the greatest amount of wear occurs at the centre of the available movement, and therefore the means of adjustment cannot be taken advantage of without the drawback of having the steering stiffer at each side of the centre than when the wheel is set for straight ahead running. A distinct advance in the safety of steering is shown on the 30 h.p. Austin, which has joints so arranged that it is to all intents and purposes impossible for the steering rod to drop. It is noticeable that many makers have now taken to staying the steering standard in some way so that it shall not "wag" on rough roads.

Brakes.—Last year on a La Buire chassis the propeller-shaft brake was placed at the back of the differential case on the back axle, the Buire construction lending itself to this arrangement. Adaptations, though not copies, of the idea are now embodied on one Siddeley-Deasy model and on a Daimler. These cars have overhead worm drive, so that the shaft is merely extended through the back of the differential casing, and on it the brake drum is fixed, which relieves the gear box and universal joints of the propeller-shaft of all braking stresses and provides a very accessible form of pedal applied brake. At the same time, it may be regarded as intensifying one of the objections of the overhead worm, as the brake drum necessarily projects above the top of the worm casing. The Straker-Squire contains an improvement which overcomes the only serious objection to the expanding type of gearshaft brake. In this position the ordinary expanding brake is very inaccessible, as the open side is in front. On the Straker-Squire it is simply reversed, so that the open or accessible side faces rearward.

Springs.—The most noticeable tendency with regard to rear springs is the number of springs that are underhung, that is, below the axle instead of above it. Its advantage, other things being equal, is that it provides a greater clearance, amounting to the thickness of the spring, between the axle and the frame. The use of the cantilever or Lanchester type of spring for rear axles is extending, but only the Lanchester cars themselves exhibit it for both back and front axles. The combination of cantilever back and half-elliptic front springs which was introduced on the Siddeley-Deasy cars is now also a feature of other high-class cars. As often as not the back springs are now threequarter-elliptic, and in a good many cases the shackles take the form of supplemental springs. On most of the best cars some form of spring damper is used on the front springs to prevent plunging, and it is also employed for the back springs when they are of the half or threequarter-elliptic type, but it is not usually employed when the cantilever type of spring is used. The practice of forming the spring shackles into one unit by connecting them by partial or entire webs is growing rapidly, and is much to be commended, as tending to equalise the wear on the shackle bolts and counteracting the tendency of the spring to rock laterally.

Wheelbase.—The lengthening of the wheelbase on small and medium-sized cars is distinctly a feature of 1914 designs. In many cases the longer chassis is merely supplied if required, and we may say we think that, unless the engine is of adequate power, it is rather a mistake, as the mere lengthening of a chassis by six inches adds very considerably to the dead weight of the chassis alone, but when it is borne in mind that the superstructure, and probably the load also, are likewise increased, it will be seen that, unless the car has previously had a good reserve of power, the engine is likely to be overloaded. When it is remembered that cars with engines of only 65 x 130 mm. are to be found with wheelbases of over 10ft., it will be admitted that our fear in this respect is not altogether groundless. What it means, roughly, is this: engines of under 2,000 c.c. are being asked to propel loads nearly as great as those which have hitherto been deemed ample for engines of very nearly double to three times this capacity. It means lower gearing and higher engine speeds.

Details of Modern Body Design

An Illustrated Criticism written after a Visit to the last Olympia Show

IT annually falls to my lot to make a tour of inspection of the work of the leading coach builders previous to the Show, and as I had to do so this year, it was no surprise to me to find at Olympia that the liveliest expressions of body building originality were to be found in the Main Hall, and not in the Annexe. One does not expect anything startlingly original from the average British coach builder, who is apparently quite content to let his rivals on the other side of the Channel ransack their brains in the endeavour to be *outré* and *bizarre*.

By Way of Introduction.

At the same time, as far as British built-to-order body work is concerned, it is quite safe to say that a certain definite amount of progress has certainly been made. There is still, of course, plenty of room for improvement in point of design, but more especially in regard to the provision which is made for certain necessary equipments which have to be carried on all bodies of whatever type. To judge from appearances, the coach builder, no less than the chassis maker, persists in regarding such a thing as a spare wheel or a tool box as something which must not be "allowed for" at any cost, but must be regarded as a necessary evil to be hung on at the last minute in order to spoil the appearance of the finished whole. The result is that these two things alone are quite sufficient to make any display of coach work far from good looking unless one takes the trouble to view all the carriages from the near side. Even then, however, a tool box or two frequently upsets the symmetry.

It is gratifying, however, to notice that coach builders, as a rule, have decided not to put all their faith in those wonderful "curves of beauty" which were so prominent a feature of cars three or four years ago. The flush-sided idea has obtained a popularity that even its most optimistic supporters could hardly have hoped for, and it is now a question if it has not been carried even a little too far—at any rate by some of the Continental coach builders, judging by a few extraordinary bodies shown at the Paris Show in October of last year.

The coach builder is, of course, very seriously hampered by many circumstances, principal among which is that there is no such thing as a standard chassis of any given dimensions. Accordingly, every built-to-order job has to be put in hand specially and has to be treated as though it were a completely new affair from start to finish. This, as is obvious enough to anyone who has glanced into the question, naturally increases the price of the finished article, but there is no reason why it should be held up, as it frequently is, as a reason for designs being lacking in beauty. With the opportunity of designing a fresh body for every order, the coach builder ought to be in a position to obtain perfection in a very short space of time by not repeating mistakes made in previous bodies; this, however, it is fairly clear he has not succeeded in doing.

The Question of Price.

Having mentioned the word "price" in connection with body work, I am reminded that the remark I most frequently heard in strolling round the body work exhibits at Olympia was something or other to the effect of, "Really, I don't see where the value comes in." For this fact we have to thank our American cousin, who has to a certain extent queered the built-to-order body maker's pitch by sending over standardised bodies which obviously are made at a sensationally low price. I am afraid that people are finding it increasingly difficult to differentiate between what is a satisfactorily working design and what is not only efficient, but is beautiful and comfortable as well.

On the other hand, there is no tendency whatever for bodies to be made any less costly and elaborate; indeed, the very reverse is the case, for even more trouble seems to have been taken by enterprising designers to ransack the markets of Europe and Asia in order to acquire the most elaborate and rare fabrics for finishing the interior of limousines and landaulets. I must frankly confess that this sort of thing does not interest me, for I am vulgar enough to consider such things as ormolu door knobs and silver-plated miniature roll-top desks out of place in a vehicle which is meant for locomotion on the road.

Everyone, however, to his taste, and, at all events, it is undeniable that coach builders would not exercise their faculties in this direction unless they knew they were satisfying a certain amount of demand from a certain class of people.

The Relative Importance of Design and Finish.

The most bitter criticism which I can make against coach builders, in general, is this—that they do not seem to appreciate in the least the value of their own work. Thus, if you ask almost any one of them before the Show if he has got anything new in the way of design, he will shake his head in a manner that shows as clearly as words can speak that he does not regard design as being anything worth talking about. And he will then switch off, without any prompting whatever, to describe in the most glowing terms the richness of the blue paint which he is going to use on his Show bodies, the wonderful tenuity of the gold lines, and the priceless character of the Levantine leather upholstery.

If all that people asked in body work was finish I could understand this attitude, but as it is I deliberately refuse to believe that this is the case. Surely the majority of us would concede that a well-designed two-seater built of packing case wood is superior, as the body work of an automobile, to a gold-plated bath tub.

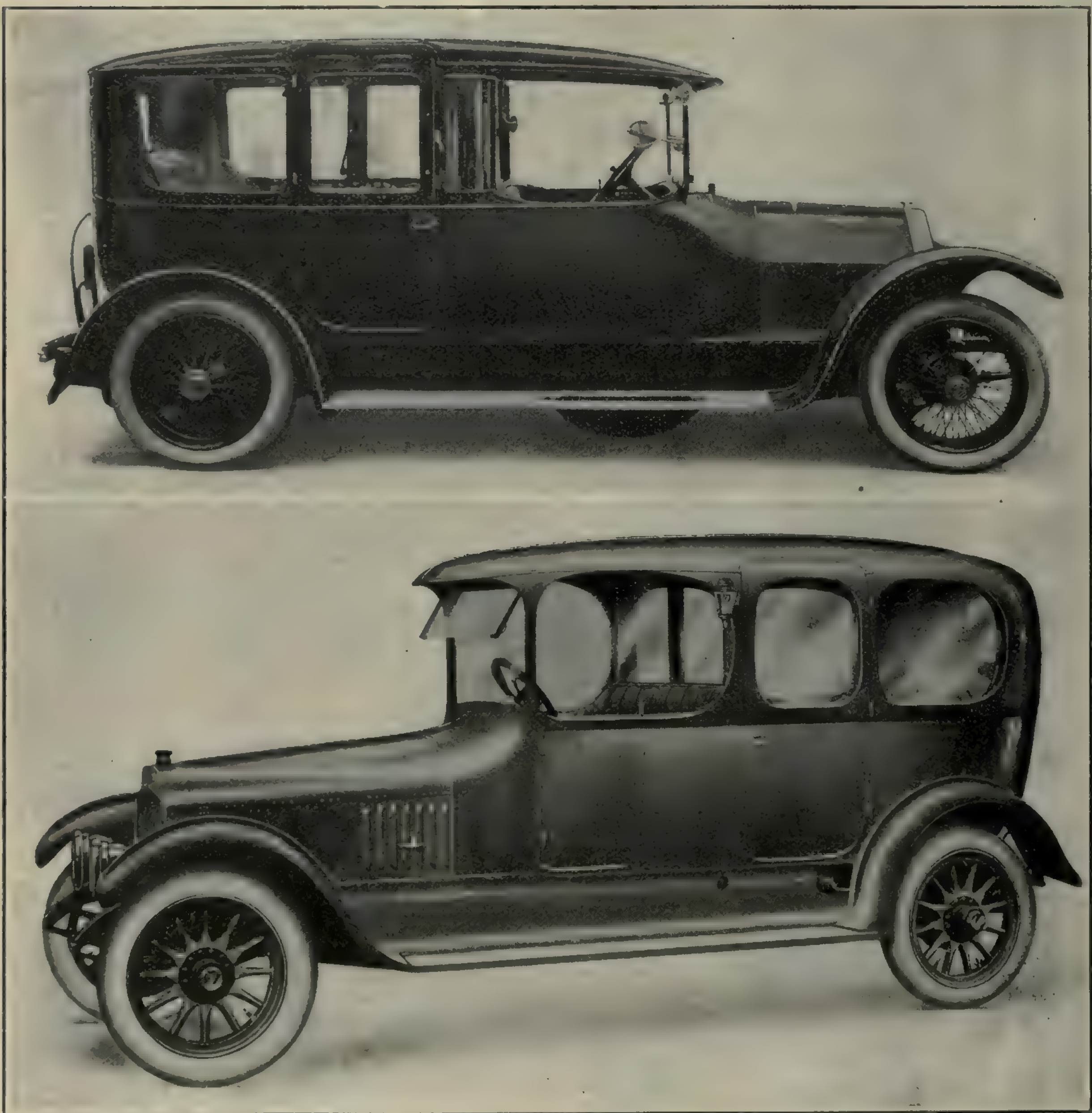
This worship of high polish and precious metals and fabrics is certainly a hindrance to the progress of design, and because it less often occurs in the minds of chassis builders than to people who specialise on body construction alone, it is not at all unnatural to find that the former are now leading the way in many respects. Thus, the Annexe had many examples of body work far more elaborate and expensive than the standard carriages mounted on the B.S.A. and Sun-

Modern Body Design.

beam chassis, yet there was certainly nothing in the Annexe which could compare with these two bodies from the point of view of originality in thought and conception, and, I might add, in practicableness.

It looks to me as though some body builders will be in for rather a thin time in the future if they do not look after their interests better. Otherwise, they will develop into manufacturers who simply make goods to the order of other people and incorporate other people's ideas in them. They must also bear in mind that in another respect they stand at a serious disadvantage to the chassis builder. The latter is in a position to see how his complete cars resist the effects of wear and tear, but once a body maker has made his carriage and sold it, he generally sees it for the last time, and, therefore, he is not in any position to judge of how it behaves. If, therefore, he has developed a little pet fault peculiar to things of his own make, he will go on embodying it time after time without realising that he is causing a lot of trouble, to say nothing of damning his reputation. This is the kind of thing which should be avoided if possible.

The Modern Limousine.



Two examples of British coachwork of the all enclosed type. The upper by Maythorn is a good illustration of a modern limousine. The lower picture is a body of similar type built by the Regent Carriage Co. on their "Metalklad" system, into which no screws or added mouldings enter, all the panel joints being made with acetylene welding. The design of the top part of the doors to the interiors of both these cars is interesting, the object aimed at in both cases being to provide extra head room by carrying the doors slightly into the roofs.

Let us see what are the principal steps toward progress which the Olympia Show proves to have been made. First of all, we have the universal acceptance of the scuttle dashboard and the tapered bonnet. This, however, can more properly be laid to the door of the chassis designer, for it was he who started this cult, and it is only fair to him to remark that the coach builder has followed him rather reluctantly, and as a matter of form, though to be sure some enterprising carriage builders had certainly suggested or actually realised scuttle dashboards before chassis constructors took them up seriously.

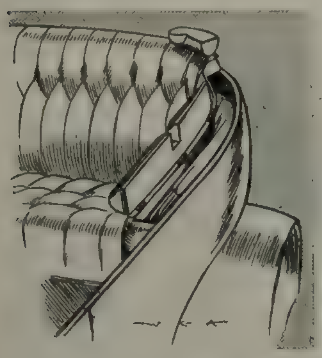


Fig. 1.—The concealed hood on a Martini car.

Next, we find that the rattlesome window is a thing of the past. Most coach builders find no difficulty in throwing overboard the old framed windows with the strap and peg adjustment, and have gone in for the popular frameless type. This is certainly a step in the right direction, though it is hardly long enough to be called a stride. It will not, however, be supposed that the frameless glass has reached a stage of perfection. The writer saw a number of instances at the Show in which it was fairly safe to prophesy that cracking of the windows would be met with, owing to the inadequate method of attaching the clip to enable the window to be lifted or lowered. In some cases a little glass thumb piece is fused into position on the window; this, of course, is the right way to treat the matter, but in many others, one finds that a metal handle, or loop, is secured by a bolt and nut fastening through a hole drilled in the glass. Unless very carefully handled, this sort of attachment is bound to give trouble and to lead to cracking.

The Bulbous Back.

Another strongish tendency is the coming of the bulbous back, even in bodies which are not primarily designed for speed purposes. This, again, is good, especially when the space thus provided is utilised as a tool box or for the conveyance of luggage. So far as the last named is concerned, however, very little has been done, and it still remains the usual thing to find that the only provision for luggage carrying is the fixing of a folding rack on the back panel, which, of course, is the very worst place one could possibly put heavy trunks, etc., owing to the fact that they tend in this position to accentuate any skidding propensities to which the car is liable.

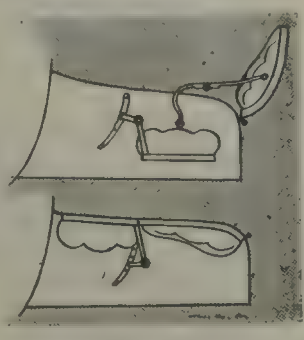
Another good thing is the one-man hood, though why on earth it has taken seven years for this exceedingly simple piece of mechanism to become firmly established is a mystery which is quite beyond me for its solution. In all but very rare cases, the head irons of landaulets, and in some cases of cabriolets also, are hidden inside the hood, which is, of course, the proper place for them. This is also good, but what is even better still is the fact that carriage builders are beginning to realise that their folding bodies must collapse really quite compactly and without overhang. There is not the slightest doubt that the bodies shown last November exhibited in the last named respect a very considerable advance on the generality of designs shown in November, 1912.

What the Owner-driver demands.

Several makers have put a lot of energy into the consideration of all-weather types of car, and in some instances the results are very promising and satisfactory. The problem is, however, an exceedingly difficult one, and it is impossible to expect a really complete solution for some years to come, judging by the rate at which progress seems to be made. It is, moreover, open to argument whether there is really much demand for a double purpose body, as the saloon limousine is rapidly gaining in popularity, and if, as seems likely, a body of this type can be turned out at a competitive price it is pretty well bound to supersede a body of the convertible type, especially as people are beginning to realise that with an all-enclosed limousine with the windows down one can have practically an open car with none of the rattlesomeness and certainly more comfort than any convertible body can possibly give one. It having been realised, however, that the principal patron of the double-purpose body is the owner-driver, it is only natural to find that in this class of work what may be called a four-seated coupé is regarded as filling the bill best.

This is a very healthy tendency, because a body which has only one door on each side can certainly be built very much lighter than one of the semi-landaulet type, and the amount of space which can be saved by doing away with the division line between the front and rear seats enables the back panel of the car to be got well inside the back axle line of the chassis, so that in many cases one finds that room has been found for a tyre or tool box at the rear without getting any noticeable overhang. This being so, folding and sliding front seats are quite common, and, generally speaking, they seem to be tolerably satisfactory.

I confess myself rather surprised at having found but one body at the Show with the provision of a space between two separate fixed front seats, so as to allow a person to pass easily between them. There is really no reason at all why this should not be done, especially as in the interests of streamline form the front part of the body can certainly be made much wider than the back. The general arrangement seems to be to make just room enough for two people in front, and to provide a rear seat wide enough for three. If things were reversed a much better state of affairs would be achieved both as regards wind resistance and in respect to general distribution of weight.



Figs. 2. and 3.—The folding dickey seat on the Zedel coupé. The double lid of the boot folds back, one portion forming the seat and the other the back-rest.

It is impossible in this article, which deals (by means of a short description and illustrations) with the principal novelties which I saw at Olympia, to make any pretence at completeness, and I am therefore afraid that several important pieces of body design will unavoidably be left out. The chief difficulty in the way of getting information was the crowded state of the stands, for no sooner would one take up a position with a view to making a thumb-nail sketch, or bring

oneself beneath the immediate attention of the gentleman in charge, than some well-meaning person would invariably push one aside, or especially if one were making a sketch, thrust himself directly into the line of fire.

Prominent amongst those who deal in chassis, and yet maintain a lively interest in body construction, is Mr. Clovis Bertrand, on whose Zedel and Martini chassis several interesting and, in details, original types of body work were to be found. Fig. 1 illustrates the arrangement of a concealed hood on a sporting type of open body fitted to a 20-25 h.p. Martini. The hood, as will be seen from the sketch, folds down into a compartment between the seat and the back panel, which is prominently bulged at the back. When out of use it is completely covered by the hinged sections of the roll of the upholstery, the whole making a very neat job. It is to be doubted, however, whether this concealed hood idea will ever obtain more than passing favour. For one thing, the Cape cart hood is very much of a makeshift, and none too efficient a one at that. Secondly, with a well of this type, one is very apt after a journey has started in the wet and finished in the fine, to put away the hood and forget all about it, when, of course, the fact that no ventilation is provided in the well is liable to cause the hood to rot.

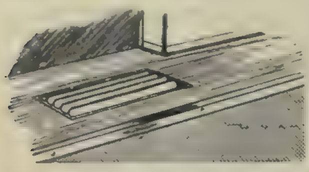


Fig. 4.—The boot scraper on the running board of an F.N. car

So far as neatness in appearance is concerned, the body in question was certainly a particularly eyeable affair, as one was quite unconscious of there being a hood fitted until the casing was opened up. This body had the growingly popular arrangement of seats with one door on either side, the front armchairs being made to pivot forward on a parallel motion.

Another body mounted on a Zedel chassis took the form of a coupé, a special point in this design being the use of a very narrow front pillar; this involves a new arrangement of the door, which was quite neatly carried out, and the whole appearance of the vehicle was very much enhanced thereby. A folding dickey, seating two, was fitted in the rear portion of this car, and is illustrated in the diagrams figs. 2 and 3. It had the great advantage of being in such a position that the rear passengers are not perched up in the usual altitude associated with dickey seats, but have their seat cushion on the same level as that of the front passengers. The method of folding the dickey down is obvious from the illustrations. A particularly good point which will not fail to be noticed is the fact that quite a large amount of space is available for luggage when the dickey is not used for seating purposes.

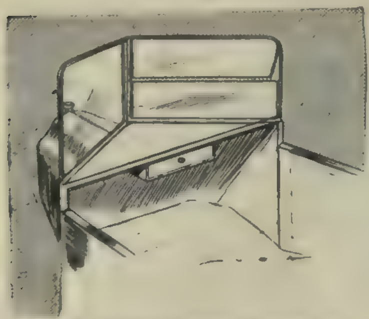


Fig. 5.—The V-shaped screen and the scuttle on a 16-20 h.p. Piccard Pictet

Those people who have cherished in their minds the fond thought that Americans cannot build presentable body work would have had a severe shock if they had taken the trouble to inspect a coupé cabriolet body on the Cadillac stand. This was a most remarkable piece of work, considering the price at which it was listed, and had reached quite as high a standard in point of view of design, workmanship, and finish as any home-built body in the Show.

It was evident from certain signs that carriage builders do not take kindly to the ordinary step mat, which, I must confess, is rather an unsightly affair. They have, therefore, in some cases incorporated something a little more permanent in the way of mud scrapers on the running board. Fig. 4 is a good example of this, and relates to a fitting on an F.N. car with carriage work by Joachim, of Liège. The boot scraper consists of five aluminium slats, cast in one with a neat framework, which is let into the wooden footboard.

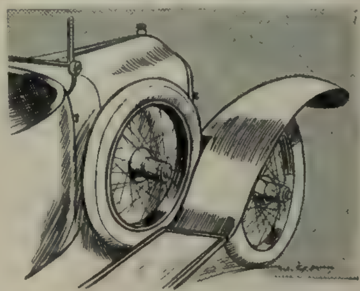


Fig. 6.—The arrangement for carrying the spare wheel on a Piccard-Pictet car.

A decidedly striking design of body was mounted on a 16-20 h.p. Piccard-Pictet. This body was of the cruiser shape, and had a peculiar formation at the stern, which was fitted with a pronounced negative flare, in which a large cupboard was incorporated, access being obtained through a hinged part of the back cushion. Another noticeable feature of this car was the fitting of a V-shaped screen, the forward stick of the Cape cart hood being shaped to suit. A sketch of this screen is given in fig. 5. Only the driver's half is made adjustable. The arrangement was by no means unsightly, and, with the hood erected, might even be said to be of pleasing appearance.

A neat detail of another body, this time by the London Improved Coachbuilders, Ltd., on another Piccard-Pictet is illustrated in fig. 6, which shows the arrangement for carrying the spare wheel, so as to allow the driver to obtain entrance to his seat on the offside of the car. The objection to carrying the spare wheel at the back of the car is the very obvious one that it is somewhat weighty, and tends to accentuate a skid when this takes place, hence it is generally considered that a position similar to that shown in fig. 6 is about the best that could be chosen. Furthermore, it is by no means inconvenient, as a little recess can be scooped out of the front wing without interfering with the steering lock of the front wheel in the least, and it is not always necessary to remove the wheel to get at the offside of the engine. It also has the advantage of leaving the whole of the running board open, so that a large amount of luggage can be carried in this position.

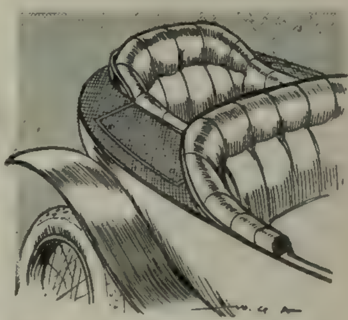
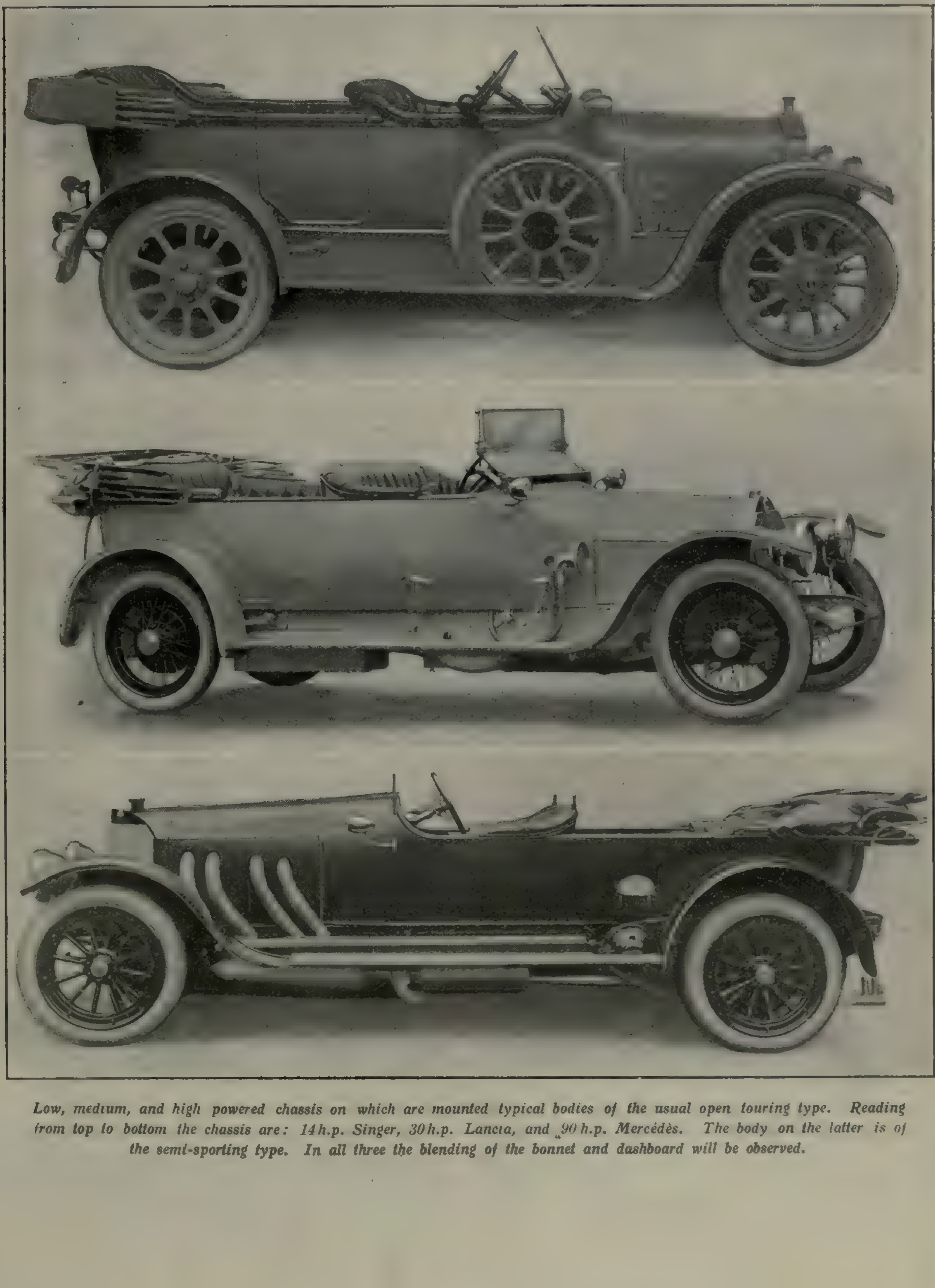


Fig. 7.—The rear seat on a Grégoire three-seated body.

The Open Touring Car—Modern Designs.



Low, medium, and high powered chassis on which are mounted typical bodies of the usual open touring type. Reading from top to bottom the chassis are: 14 h.p. Singer, 30 h.p. Lancia, and 90 h.p. Mercédès. The body on the latter is of the semi-sporting type. In all three the blending of the bonnet and dashboard will be observed.

Modern Body Design.

It would appear as though a demand had arisen for something between the ordinary two-seater with a dickey and the full-sized four-seated touring car. This demand was exemplified by several instances of a rigid three-seater, of which a very good example is that mounted on a Grégoire chassis, which has its rear part illustrated in fig. 7. Here one has a comfortable, properly-built rear seat, flanked on each side by a capacious tool and spares cupboard. The only objection to this design is the difficulty which the rear passenger has in getting into and out of his seat, otherwise it is certainly very much preferable, on a sporting type body to the ordinary dickey. No hood was mounted on this car, but it would not be a difficult matter to fit one so as to cover the rear passenger as well as those on the front seat. A rather notable feature of this Grégoire body design is that the boat formation is carried out without being in any way aggressive.

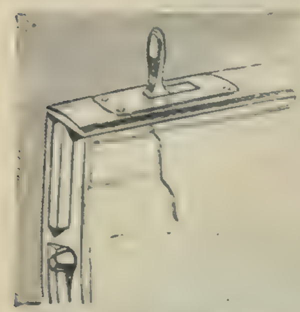


Fig. 8.—The Sunbeam door latch.

Those Continental importers who refrained from bringing over the full-blown boat bodies which created such a sensation at the Paris Salon were no bad judges of the public for whom they are catering over here. For it is quite safe to say that this kind of body will never gain much popularity in England, where motorists have a habit of demanding a little more protection against the weather than is afforded by a very narrow shell entirely unprovided with a wind screen or Cape cart hood, and designed to be of such a form that the maximum amount of windage is met with by the passengers.

Fig. 11.—The arrangement of the dickey seat and side lockers on an Hispano-Suiza boat body.

The sliding seats on the 12-16 h.p. Sunbeam standard body are exceedingly neatly arranged and carried on a pair of slide rails, to which they can be locked in any position by a single central lever. Another good feature of this body is the door locking arrangement; a sketch indicating the principal feature is given in fig. 8. This shows the handle and also the peculiarly shaped taper bolt of the lock. The bolt of the lock is round and the end tapered. When the door is shut this tapered end engages with a tapered hole in a striking plate in the pillar, but is so arranged that the bolt, when engaged, does not travel out to its full extent, so that when the frame and the body bend and the door and pillars move away from, or towards, each other, this tapered end bolt is allowed to extend, or is pushed back as the case may be. Owing, however, to the strong spring always forcing it outwards, the tapered end never fails to engage with the tapered hole; therefore although the door cannot move up or down, or sideways, it allows the body to open or close freely and without rattle. Between the standing pillar carrying the hinges and the door there is a spring plunger or rubber buffer, which prevents any noise in the hinges, should the hinge pins wear. In addition to these fittings there are on the other pillar two rubber buffers, against which the door closes. It is claimed that in practice over a particularly bad road, although the bending of the frame is sufficient to cause the door pillars to open and close a matter of ⅛in., no rattle or squeak occurs. It may also be remarked that this Sunbeam body was almost the only one in which a proper provision for tools, etc., was made under the rear floorboard. The Lancia standard body also has this point, for which both firms are to be highly commended.

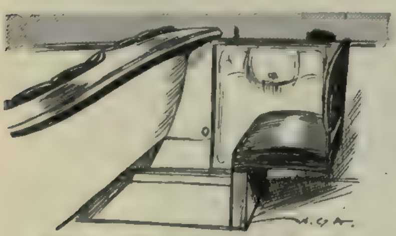


Fig. 9.—The Opel emergency seat.

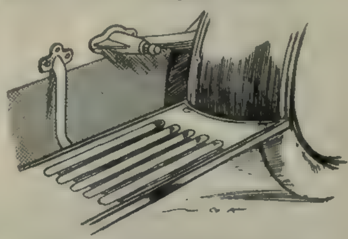


Fig. 10.—A boot scraper formed in the running board of the Hispano-Suiza sporting car.

There is one direction in which the Continental coach builder seems easily to excel his English rival, and that is particularly in the arrangement of occasional or folding seats. Those who question the truth of this statement could have very many instances in support of it given to them at the Show. Amongst them, a particularly good example of neat work was the folding chair arrangement in the rear part of the Opel torpedo. This is shown in fig. 9. The seat is of a simple, rigid, and extremely comfortable type, and does not have to be carefully folded up, but collapses quite automatically when it is pushed forward. It then lies flush with the floor and occupies no useful room whatever. In order to protect it as far as possible from the weather, a sort of secondary scuttle is arranged behind the front seats. The seat is not movable, but there seems to be no hardship in placing one's occasional passengers so that they face forward.

Fig. 10 shows a rather interesting little detail on a Lucas body mounted on a very sporting Hispano-Suiza. Incidentally, one may remark that this body had evidently been designed more for Show purposes than for use, as was quickly apparent when one tried to sit in it. However, with some small modifications, it would be perfectly comfortable and practical. The detail in question relates to the construction of the running board. Here one had the step mat idea in a rather peculiar form, the running board being grooved out in five or six longitudinal V-shaped grooves, and on the ridge between each two there was placed a thin strip of brass to protect the

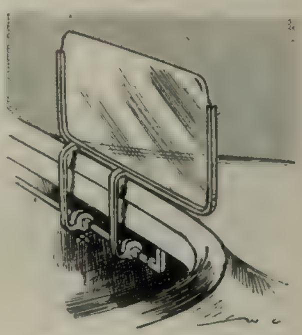


Fig. 12.—The driver's screen on the Hispano-Suiza boat body.

woodwork, but if this device were incorporated for purposes of cleanliness, then it would surely be very much more difficult to clean out the mud from the grooves than to sweep it off a plain footboard.

The idea of lightening running boards, although not a new one, is certainly one that demands some little acceptance, as there is no doubt that a great deal of unnecessary weight is carried at this point. The fitting of a foot scraper was achieved in a more practical manner by the Portholme Carriage Co. on the footboard fitted to a Berliet limousine. This footboard was a piece of cast aluminium, grooved both above and below, but the depth of the grooves was such that they could be very easily cleaned out.

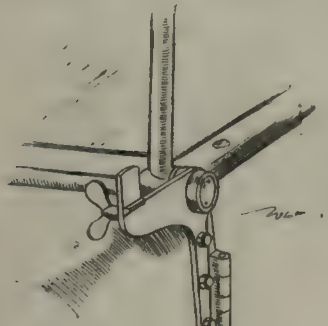


Fig. 13.—The B.S.A. combined side lamp bracket and screen and hood support.

In fig. 11 is shown another detail of an interesting Hispano-Suiza body designed by Lookers, of Manchester. Here one has a full-blooded example of the boat body design carried out on a two-seater (or rather a three-seater, as a commodious dickey is carried in the tail part). This body closely approximated to true streamline form, and had this very great advantage that room was provided underneath the dickey seat for the carriage of a complete spare wheel. The dickey itself was bounded on each side by two exceedingly capacious tool cupboards, these being large enough to hold several petrol tins, to say nothing of a supply of tools and spares, and possibly even a suit case might have been put in.

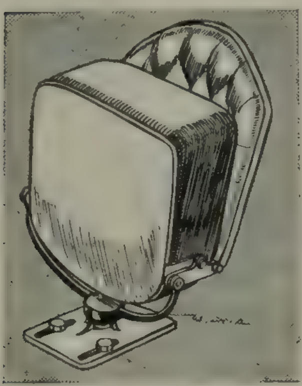


Fig. 14.—The B.S.A. folding, swivelling, and adjustable front seat.

The egg-shaped formation of the body resulted in the front seats being rather too low to suit everybody's taste, as it was not possible when sitting down at the wheel to see the edges of the front mudguards, not, however, that this is an essential point, as one very soon grows accustomed to judging distances, and no accident is likely to be caused by this fact, if the driver be at all experienced. The sketch also illustrates the small flap which is arranged in front of the dickey seat passenger, in order to afford him some little protection against the elements.

Fig. 15.—The luggage space on the B.S.A. two-seater.

Fig. 11 also shows the peculiar little wind screen which is placed in front of the driver. This is shown in further detail in fig. 12, which illustrates its mode of attachment. This screen is so arranged that when not required it can be swung completely out of use and housed underneath the scuttle dashboard. For this purpose it is carried on a slide rail, which is normally round, but is fitted with a couple of squares, so that the squared holes in the bracket can be slipped on to them, thus holding the screen rigid, and it can further be secured by a small thumb-nut. By fixing another rail and a similar screen on the other side, the same arrangement can be made for the passengers' comfort. The idea is certainly ingeniously carried out, but it is difficult to see how it has any important advantage over an ordinary single folding screen of a suitable size.

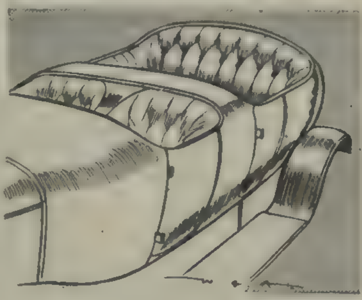


Fig. 16.—The Berliet torpedo body; the sketch shows the rotund sides.

In my opinion the B.S.A. cars, both two-seater and four-seater, were, in their way, if not the very best examples of modern body design, at least amongst the best in the Show. This, of course, is only given as an opinion pure and simple. It seems, however, as though the designers had set about their job in a more thorough and workmanlike manner than I had seen before. To start with, the whole of the shell is built up on a principle which involves cast aluminium corners, which carry beaten steel panels, the whole forming an exceedingly rigid and light construction. Body building is, of course, very considerably simplified when one has only one kind of chassis to consider, and where one is restricted in body types to two or three at the most.

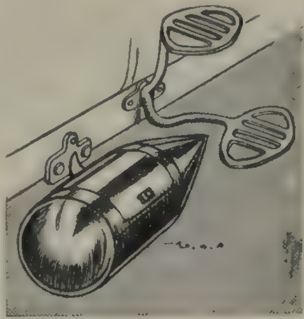


Fig. 17.—The double step irons and the streamline toolbox on a Panhard car with body by Labourdette.

As it is, however, I consider that the B.S.A. design was exceedingly meritorious, as one could not find a single detail on the cars that had not received thorough and exceedingly workmanlike attention. The detail illustrated in fig. 13 is a good case in point, and shows the neat, treble-purpose bracket, which acts as a support for the side

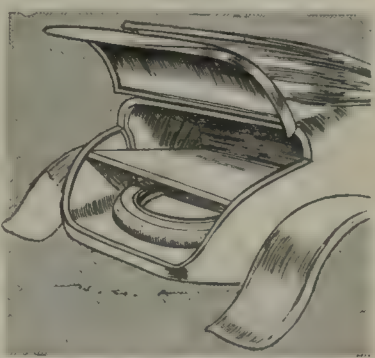


Fig. 18.—The two-compartment boot of an Adler two-seater.

Modern Body Design.

lamp, as a support for the single wind screen, and as an anchorage for the hood. The last named is a particularly cleverly arranged little affair, and is erected in a manner which can be represented as a cross between the ordinary hood and an umbrella. The result is that the sticks are very short and lie down very compactly. They are only "sticks" in name, as they are composed of thin steel tubes of a D section. One can also put the hood up without necessitating either the driver or the passenger getting out of the car.

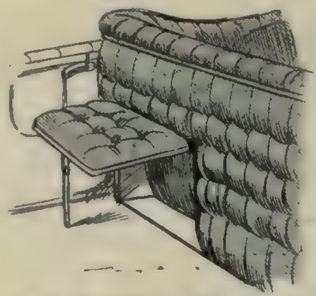


Fig. 19.—The Singer emergency seat.

Fig. 14 is a sketch of the very well designed folding chair used as the front seat of the standard-type four-seater on the B.S.A. This, it will be observed, is adjustable fore and aft by undoing two nuts. These folding chairs appeared to be very comfortable as well as light. A single side-entrance door is used on either side of the car.

Perhaps the most interesting feature of the B.S.A. two-seater was the fact that behind the seat back, which was adjustable as to angle, was to be found a space quite sufficient for the carrying of a set of golf clubs and one or two suit cases. This arrangement is illustrated in fig. 15, which also shows partially the construction of the hood. The luggage in the illustration is thrown purposely open to view, but by merely pulling part of the hood canvas forward one could cover it all up so as to make everything stored in the space below snug and dustproof.

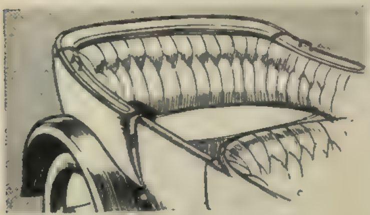


Fig. 20.—The Sheffield-Simplex concealed hood casing.

It may be said that it is not generally recognised that one of the principal desiderata in connection with the carriage of luggage is that it should be entirely weatherproof. So far as I know, no ordinary suit case has yet been made which is capable of withstanding any hard wear in a state of dampness, dust, and mud, and the same trouble exists to a particularly grievous extent in connection with golf clubs. If these are put on to the car in an uncovered condition they are seriously damaged both in material and in appearance, and, generally speaking, it is very difficult to find room for them. On a very neat torpedo body on the Delahaye stand room had been found for a couple of sets of golf clubs underneath a cupboard which was fixed to the panel dividing the front and rear seats.

Several cars in the Show illustrated the influence which boat body designs across the Channel have had, especially in bodies of the sporting type.

Fig. 16 shows the design of the rear part of a smart torpedo body, fitted on a Berliet chassis. This in common with a number of other cars at the Show had a coaming behind the front seat, which certainly very much neatens the appearance of the whole, and, at the same time, makes the rear part a little more weather proof

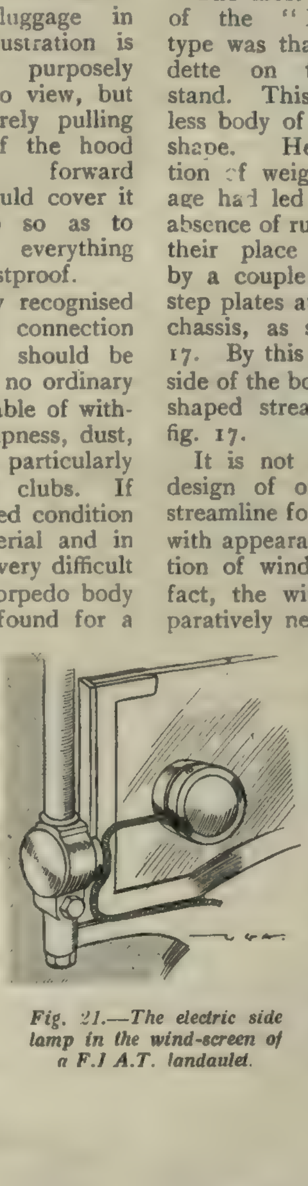


Fig. 21.—The electric side lamp in the wind-screen of a F.I.A.T. landaulet.

Here one has, to a notable extent, the rounded side, which is so much coming into favour, and which was also to be found on the sporting bodies fitted to the R.M.C., D.F.P., Crossley, and Vauxhall chassis. It is, perhaps, a matter of opinion whether this formation results in roominess. My personal impression is that it does not, as, although it allows more knee room, it certainly does not allow more shoulder or elbow space.

The reverse fashion was well exemplified in the very excellently designed standard body fitted to the 15-20 h.p. Métallurgique chassis. Here one got a definite flare with the curvature of the panels in the exactly opposite direction to those shown in fig. 16. I am rather inclined to think that this is the better arrangement, as in cars of a fairly fast character it certainly is by no means a disadvantage to obtain a sort of wedging action on the seat; at the same time, the flare of the panels gives one all the elbow room which one could require. From a streamline point of view, there is not much to choose between the two types, as in any case the passengers offer a very considerable interruption of the flow of air.

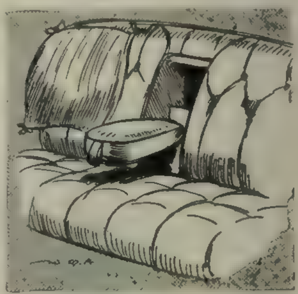


Fig. 22.—The luggage pocket in the centre of the back seat of a D'Ieteren body on a Delaunay-Belleville.

The most striking body of the "Neo-French" type was that by Labourdette on the Panhard stand. This was a doorless body of very peculiar shape. Here consideration of weight and windage had led to the entire absence of running boards, their place being taken by a couple of cast steel step plates attached to the chassis, as shown in fig. 17. By this means one is supposed to climb over the side of the body in the absence of doors. The torpedo-shaped streamline tool box is also to be noted in fig. 17.

It is not too much to say that in regard to the design of ordinary touring bodies for motor cars, streamline form is of more importance in its connection with appearance than in having any effect upon reduction of wind resistance, because, in point of actual fact, the windage of ordinary cars absorbs a comparatively negligible amount of h.p. up to about fifty miles an hour, and, as there are very few cars that ever exceed this speed except for short stretches, it is obvious that the matter is a very trivial one. Where the French school of motor body builders go so hopelessly wrong is that their designs are not only ludicrously ugly, but by no means efficient from the windage point of view. It may be taken as an axiom that the more eyeable a body is the better is it in regard to windage efficiency.

Fig. 18 illustrates a very neatly constructed cupboard in the rear of a smart little Adler two-seater This is large enough to carry a suit case, to say nothing of quite a large quantity of tools

and a spare tyre, which is shown in position in the lower compartment. The general shape of this tail part is very pleasing, and is certainly much more appropriate than the flat, box-like affair that is used on the generality of two-seaters.

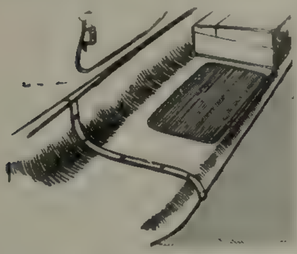


Fig. 23.—The combined running board and valance on a Delaunay-Belleville. Behind the rubber mat is a tool-box sunk partly through the running board.

The body used on the standard 20 h.p. Singer car contains a very nice piece of design in the folding occasional seats, the arrangement of which is shown in fig. 19. When out of use these seats fold up and fall flush with the padded back of the driver's seat, and for this purpose the front supporting leg is made collapsible.

One of the strangest bodies in the Show was a convertible two or four-seater, mounted on an Itala chassis, this work having been carried out by Meier, of Redhill. I cannot say that this arrangement struck me as being in any way desirable, as when in the form of a two-seater it was certainly decidedly ugly, in spite of the ingenious arrangement of the hood and folding rear panels and flanks. It certainly looked much better as an open four-seater, but, even so, to use a vulgarism, it was nothing to write home about. I should say that the average person would very much prefer the usual folding dickey, and one must look upon this type of body as being, therefore, in the nature of a *tour de force* rather than a practical solution of any particular difficulty.

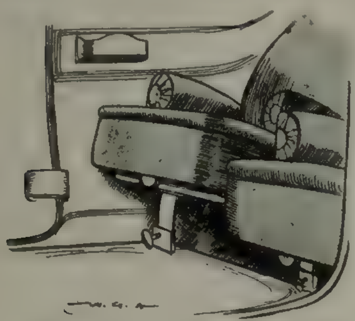


Fig 24.—The adjustable rear seats on a Delaunay-Belleville limousine.

One arrangement of a concealed hood has already been illustrated and described. Another is shown in fig. 20, which depicts the design adopted on a Vanden Plas open torpedo mounted on a Sheffield-Simplex chassis. This body was certainly a very fine and very graceful piece of work, and the concealment of the hood is certainly quite neatly carried out, as it does not detract to any serious extent from the appearance of the design. The leather cover which acts as a lid over the hood cavity is carried on the front hood stick and goes forward with it.

Fig. 25.—The tool board under the door pocket panel on a Rolls-Royce car with body by Thrupp and Maberly.

In order to allow full roominess in the width of the rear seat, the hood compartment, it will be observed, is carried outside the line of the shell, and finished off each side with a "round corner."

A peculiar little detail of the new F.I.A.T. *carrosserie* is shown in fig. 21, which refers to an illegally placed but very neatly arranged side lamp on the landaulet. The lamp is stuck into the lower panel of the glass screen, and is practically unnoticeable, on account of its small size and the absence of any bracket. It does not by any means show the full width of the car, and on this account is to be deprecated rather than applauded.

Messrs. D'Ieteren Frères had, as usual, some very fine examples of their carriage work on the Delaunay-Belleville stand. In fig. 22 is shown the arrangement of a very convenient little luggage pocket between the two rear seats of the landaulet. The lid of the pocket forms an elbow rest. The down cushions are typical of the standard of luxury affected by this maker.

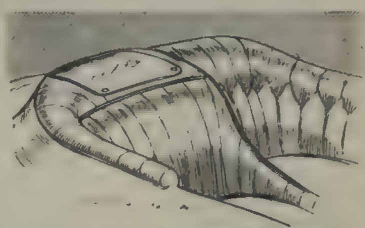


Fig. 26.—The luggage compartment behind the driver's seat on a Delage two-seater.

A rather striking idea in running boards was used on a D'Ieteren Delaunay-Belleville limousine, and of this detail a sketch is given in fig. 23. The running board is of steel, and forms a single piece with the valance. A wooden tool box is sunk into it, and where the passengers are likely to step on it a rubber mat is attached with a small brass rail in front which prevents chipping of the black enamel. The arrangement certainly looks light, neat, and easily cleanable, but it is, no doubt, a somewhat expensive method of construction. The rear portion of this limousine was fitted up with two adjustable armchairs, the design of which is clearly shown in fig. 24. They are very easily tilted forward or backward, and were certainly exceedingly comfortable. Two occasional seats were let into the rear division behind the driver's seat, and when out of use were invisible; though, truth to tell, they were not of a particularly comfortable type when opened out. It is a question, however, whether it is necessary to provide luxurious armchairs for this type of work.

Fig. 27.—The Armstrong-Whitworth folding seat.

Messrs. Thrupp and Maberly had a very neat and attractive looking open touring torpedo on the Rolls-Royce stand. One of the neatest features of this was the provision inside the door of a tool rack, which is shown opened out in fig. 25. This does not interfere with the fitting of the usual leather pocket, and it certainly is a very convenient way of making use of a space which is far too often wasted.

I suppose it would be generally conceded that the body that attracted most attention was a peculiarly designed and highly characteristic little saloon-limousine on a small Gladiator chassis. This was even more noticeable because it was entirely finished in bright metal. My own view is that the tendency which this body and several others in the Show illustrated of mounting large bodies on tiny little chassis is a very deplorable one, and I believe that the manufacturers of these chassis would be very well advised to discountenance any further continuance of this practice, as the overloading of small engines is bound to lead to trouble in the end.

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The Calthorpe Co. showed a very natty reduced model of a saloon limousine on one of their Calthorpe Minor chassis. This, however, was only a two-seater, as the seat at the rear was not intended for use, but was merely the padded top of a luggage compartment. No doubt such bodies would strike a pigmy as exceedingly desirable affairs, but to the ordinary average-sized man these very small enclosed bodies have an atmosphere of crampedness which is not particularly pleasing. So far as I know, they may have sold like hot cakes, but, judging by appearances, this sort of thing was evidently regarded as a Show curiosity rather than anything else.

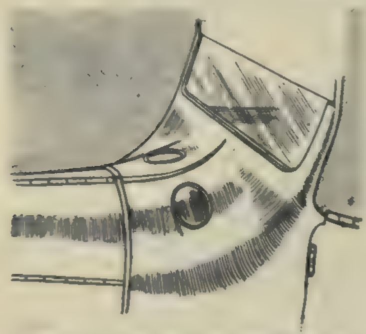


Fig. 28.—The concave scuttle, with two elliptical lights, and the lower half of the driving screen on the Armstrong-Whitworth landaulet.

In fig. 26 is given a sketch of a luggage compartment on a six-cylinder Delage two-seater. This is placed behind the driver's seat, and is covered by a hinged leather flap, which makes it waterproof. There did not seem to be any particular reason why the same thing should not have been done behind the passenger's seat. Presumably, however, the car was designed for a very short driver and a very tall passenger, as there was no lack of room on the chassis for more commodious luggage accommodation. The "Compendolette" body on a Clément chassis, built by the Regent Carriage Co., has already been referred to in *The Autocar*. This seemed to have some rather good points, as it certainly could be converted from a totally enclosed saloon limousine type of body into an open touring car in a very short time, and the hood collapsed very neatly, to say nothing of the clever concealment of the windows.

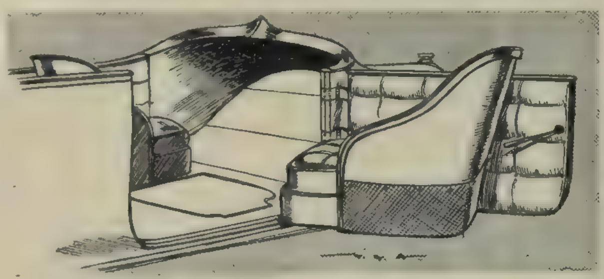


Fig. 30.—The front seats opening with the doors on the Spyker boat body.

Fig. 27 shows the design of a folding front seat on the Armstrong-Whitworth coupé-cabriolet, which, in common with several others in the Show, was of the four-seater type without a front division. These seats swung forward very freely and easily, and were certainly when in use rigid and comfortable, which cannot be said of all folding armchairs by any means. Another Armstrong-Whitworth chassis was fitted with a landaulet body, this having a rather peculiar design in regard to the mounting of the wind screen in connection with the scuttle dashboard. This is shown in fig. 28, in which it will be seen that the lower half of the screen practically forms a curved upward continuation of the scuttle. The latter has a couple of elliptical glass lights let into it. One is inclined to suppose that the carrying out of this job is decidedly expensive, and perhaps out of proportion to the result attained.

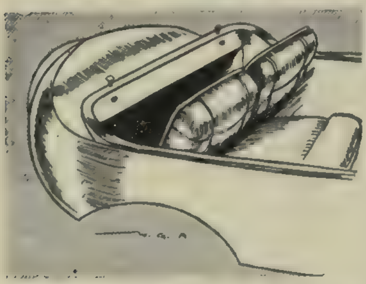


Fig. 29.—The hinged back squab of the rear seats on the Spyker boat body. The compartment behind will accommodate luggage and spares.

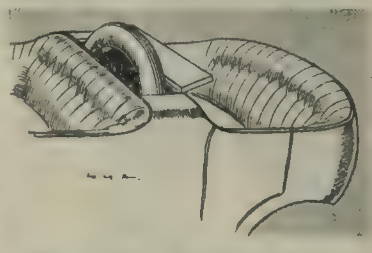


Fig. 31.—The spare wheel locker on the Hurtu four-seater.

The cult of the armchair seat was found in full favour on two bodies fitted to Baguley chassis. One of these carried a body in which a very low rakish appearance had been obtained at the expense of the comfort of the passengers, as the level of the seat-squabs was only an inch or two below the edge of the side panels, and if one sat in this body one had a horrible feeling that one would tumble out at the very first suggestion of a corner. In this case, the front seats were separately adjustable, and were fitted on rails and made to move by means of a screw and nut device. The pitch of the screw was, however, so slow that it took one an appreciable time to move the seat an inch, though when it was got into the required position it was certainly very secure and rigid.

A very striking looking and highly individual design of boat-body was mounted on a Spyker chassis, and the arrangement of the tail end of this is shown in fig. 29. It will be seen that the back cushion of the rear seat folds forward and gives access to the large cupboard in the turned up tail. A peculiar feature in this design was the use of a very pronounced fish-back spine running down the body and up the scuttle. This looked as though it would seriously interfere with the fitting of a screen, though the designer of the body assured me that this was not so. The running board on this car was of the skeleton type, but particularly notable was the arrangement of the front seats. This is shown in fig. 30, from which it will be seen that each of the front armchairs is fixed to the single side door and swings outwards with it. The natural result of exhibiting a body of this

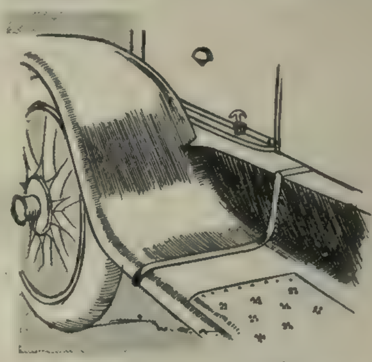


Fig. 32.—The one-piece wing, running board, and valance on the Miesse landaulet. A roughened steel plate is provided to ensure a foothold.

type in the Show was, of course, that some stout man of about 16 stone sat in the chair and was treated by his good wife to the amusing experience of being swung out of the body and in again. That the triple hinges of the door stood up to this maltreatment is a high tribute to their strength, but certainly a very severe stress was imposed upon the body. With the chair and the door swung inwards, the weight of the passenger was taken on the floor of the car and not on the hinges on the door.

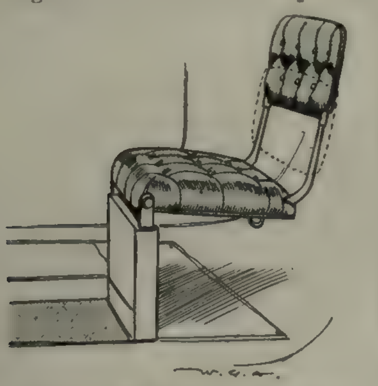


Fig. 33.—The Miesse folding emergency seat.

I have already referred to the fact that the majority of body builders entirely neglected to consider the spare wheel. An exception to this rule was to be found on a body on a Hurtu chassis. As shown in the sketch fig. 31, the spare wheel, or rim and tyre, is carried in a compartment behind the driver's seat, where it is entirely covered in by a lid which forms part of the rounded "deck." In addition a space was provided for tools and spares at the bottom and at each side of the spare wheel compartment.

In the sketch fig. 32 an illustration is given of a very neatly carried out running board design on a Miesse landaulet. Here it will be seen that the front mudguard, running board, and valance are all in one piece of beaten steel, reinforced on the running board with a thicker plate of steel, which is roughened to prevent one's shoes slipping. A better idea would certainly have been to have turned up the inside edge of the plate so as to make sure of preventing one's boot toe engaging with the paintwork of the valance. A cleverly designed collapsible occasional seat is illustrated in fig. 33. The back is fitted on two telescopic supports, and can be extended to any convenient height. When out of use, the support of the seat folds flush with the floor, whilst the seat and the back cushion collapse into a compartment in the rear division behind the driver's seat.

W. G. ASTON.

Road Racing in the Isle of Man.

The 1914 Tourist Trophy Race.

THIS year a two days T.T. Race is to be held in the Isle of Man on June 10th and 11th under R.A.C. rules. It promises to be a far more interesting event than its predecessors, partly on account of the interval of time which has elapsed between the date of the last event (1908) and the one now forecasted, and the fact that vast strides have been made in design and manufacture since the "four inch" race of 1908, so-called on account of the cylinder bore being limited to 4in. (101.6 mm.). The weight of the chassis was limited to 1,800 lbs.

The principal regulations for 1914 are as follow: Maximum engine capacity 3,310 c.c. (a 90 mm. × 130 mm. four-cylinder engine has a cubic capacity of 3,308 c.c.), minimum weight 21½ cwt. with driver and mechanic, width of track 4ft. 6in., wheelbase 9ft., width of seat 34in. measured from outside.

Fuel tanks must hold fifty gallons and carry sufficient petrol for the two days.

No fuel will be eligible for the fuel prize which contains more than 10% of petrol. The petrol definition is "petroleum spirit of which not less than 90% distils below 150° C. (302° F.)."

No outside assistance will be allowed, and there will be only one replenishment depot from which only the driver and his mechanic will be allowed to take oil, fuel, spares, etc., under official observation.

The total distance will be about 600 miles, 300 miles each day.

The entries are as follow:

Car.	Bore and stroke in millimetres.	c.c.
Minerva I.	90 × 130	3,308
Minerva II.	90 × 130	3,308
Minerva III.	90 × 130	3,308
Humber I.	82 × 156	3,295
Straker-Squire I.	93 × 120	3,260
Straker-Squire II.	93 × 120	3,260
Sunbeam I.	80 × 160	3,217
Sunbeam II.	80 × 160	3,217
Sunbeam III.	80 × 160	3,217
Humber II.	82 × 156	3,295
Humber III.	82 × 156	3,295
Star I.	90 × 129	3,282
Star II.	90 × 129	3,282
Vauxhall I.	90 × 130	3,308
Vauxhall II.	90 × 130	3,308
Vauxhall III.	90 × 130	3,308
Martini I.	85 × 130	2,940
Adler I.	90 × 130	3,308
Adler II.	90 × 130	3,308
Adler III.	90 × 130	3,308
Pipe I.	— —	—
Pipe II.	— —	—
Pipe III.	— —	—
D.F.P	70 × 130	2,001
S.A.V.A.	— —	—
Rawlinson-Hudson	— —	—
Crossley	— —	—

A Brief Resumé of Previous Races in the I.O.M.

The first race—in 1905—was run on fuel consumption limited to one gallon per 22.5 miles; each chassis had to weigh 11½ cwt. and not more than 14¼ cwt. The winner was J. S. Napier, driving an Arrol-Johnston fitted with a two-cylinder four piston engine. His speed averaged 33.9 m.p.h.

In 1906, consumption was cut down to 25 m.p.g., the chassis had to carry a weight of 10½ cwt. made up of the body, driver, mechanic, and ballast. The race was won by Rolls (four-cylinder Rolls-Royce) at an average of 39.3 m.p.h.

The year 1907 saw two separate races—the Tourist Trophy and the Heavy Car Race—although they were run simultaneously over the same course. The T.T. cars were limited to 25 m.p.g. of petrol, and the load to be carried 12½ cwt., heavy cars 16 m.p.g. and weight carried 20 cwt. Courtis (four-cylinder Rover) won the T.T. on wet heavy roads at an average of 28.8 m.p.h., and Mills (four-cylinder Beeston Humber) the Heavy Race at an average of 28.7 m.p.h.

In 1908, the Tourist Trophy Race was replaced by the "four inch" race. Minimum chassis weight was fixed at 16 cwt. unladen. The race resulted as follows:

1. Watson (Hutton) ... 50.25 m.p.h.
2. Lee Guinness (Darracq) ... 50.0 m.p.h.
3. George (Darracq) ... 49.6 m.p.h.

The engine size of the winning Hutton was 102 × 177.8 mm.

The AUTOCARS of 1914.

"THE BUYERS' GUIDE."

An alphabetically arranged table of Cars at present on the British Market, with the chassis and complete car prices, principal mechanical features, and leading dimensions.

IMPORTANT NOTE.—The prices given are those ruling in Great Britain. To these must be added the cost of freight, import duties where they exist, and agents' charges. A list of the freight charges and import duties in the various countries will be found on page 40.

The columns are so nearly self-explanatory that with the exception of the following nothing requires definition:

PRICE:
Car complete. The chassis is fitted with an open touring body, tyres, tools and spares, but not with lamps, hood, screen, etc., unless specified in a footnote.
Chassis means with tyres, tools and spares, unless specified otherwise.

IGNITION:
Mag. = Magneto only. *M. Acc.* = Magneto and Accumulator (separate systems).
Dual = Magneto and Accumulator combined.

WHEELS:
F indicates fixed and D indicates detachable. Thus R.-W.D. represents Rudge-Whitworth detachable.

BODY SPACE:
The body space is the length of the frame behind the dashboard.

TYRES:
Unless otherwise stated by a footnote front and back tyre sizes are the same.

H.P., Name of Car, Number of Cylinders, and Country of Origin.	Tax in Gns.	Bore and Stroke.	Cubic Capacity.	Price. Chassis with tyres.	Price. Car Complete.	No. of Seats.	Ignition	Carburetter.	Clutch.	No. of Gears	Final Drive.	Wheels.	Rims.	Wheelbase.	Track.	Extreme Length	Road Clearance.	Length of Body Space.	Dash to Back Wheel Centre	Tyres.
		mm.	c.c.											ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	mm.
16-20 Aberdonia (*4*) ... England	6	89×127	3168	£400	—	—	Mag.	S.U.	Multiple disc	3	Bevel	Wood, D. ...	Fixed ..	10 6	4 8	14 10	9½	8 6	7 6	820×120
*10 A.C. (*4*) .... England	3	59×100	1094	—	£175	—	Mag.	Zenith ..	—	3	Worm	Sankey, D. ..	Fixed ..	8 3	3 10	10 6	9	—	—	700×80
* 8.1 Ace (*4*) .... England	3	56×76	749	—	£125	2	Mag.	Sthenos	Plate	3	Chain	Wood, F. ...	Fixed ..	7 2	3 9	10 0	10	—	—	700×65
*10-12 Adams (*2*) ...... England	3	85×96	1090	—	£130	2	Mag.	Stewart .	—	2	Chain	Wire, F.	Fixed ..	7 6	4 6	10 6	7½	—	—	700×80
*16-20 Adams (*4*) ...... ,,	6	88×120	2918	£350	£410	5	Mag.	Claudel..	Leather cone	4	Bevel	Sankey, D. ..	Fixed ..	10 0	4 7½	—	9	7 0	7 2¼	815×105
9 Adler (*4*) .... Germany	3	65×98	1301	—	£200	2	Mag.	Zenith ..	Metal cone..	3	Bevel	Wire, F.	Fixed ..	7 10	3 7	—	—	—	—	700×85
11-16 Adler (*4*) ...... ,,	3	67×110	1552	—	£335	4	Mag.	Own	Metal cone..	4	Bevel	Wood, F. ...	Fixed ..	8 10	4 2	—	—	—	—	760×100
14-18 Adler (*4*) ...... ,,	4	75×118	2080	—	£395	4	Mag.	Own	Metal cone..	4	Bevel	Wood, F. ...	Fixed ..	9 3	4 5	—	—	—	—	820×120
15-25 Adler (*4*) ...... ,,	4	80×130	2610	—	£515	4	M. Acc.	Own	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 6	4 6	—	—	—	—	820×120
20-30 Adler (*4*) ...... ,,	6	86×135	3137	—	£565	4 or 5	M. Acc.	Own	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 6	4 6	—	—	—	—	820×120
25-35 Adler (*4*) ...... ,,	6	92×148	3935	—	£640	4 or 6	M. Acc.	Own	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	11 0	4 6	—	—	—	—	895×135
35-45 Adler (*4*) ...... ,,	8	114×160	6528	—	£715	4 or 6	M. Acc.	Own	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	11 6	4 6	—	—	—	—	895×135
55-65 Adler (*4*) ...... ,,	10	125×160	7853	—	£765	4 or 6	M. Acc.	Own	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	11 6	4 6	—	—	—	—	935×135
*15 Albion (*4*) (shooting) Scotland	4	79×127	2490	£365	£434	8	Mag.	Own	Plate	3	Worm	Wood, F. ...	Fixed ..	9 0	4 11	13 6	11½	9 2½	7 3	880×120
*15 Albion (*4*) (shooting) ,,	4	79×127	2490	£370	£444	10	Mag.	Own	Plate	3	Worm	Wood, F. ...	Fixed ..	9 0	4 11	14 0	11½	9 8½	7 3	880×120
*15 Albion (*4*) (country house)	4	79×127	2490	£365	£500	8	Mag.	Own	Plate	3	Worm	Wood, F. ...	Fixed ..	9 0	4 11	13 6	11½	9 2½	7 3	880×120
*15 Albion (*4*) (country house)	4	79×127	2490	£370	£510	10	Mag.	Own	Plate	3	Worm	Wood, F. ...	Fixed ..	9 0	4 11	14 0	11½	9 8½	7 3	880×120
15-30 Alda (*4*) (short) .France..	6	85×140	3167	£420	£550	4 to 6	Mag.	Solex ...	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 8	—	14 8	—	8 2	7 6	815×105
15-30 Alda (*4*) (long) .. ,,	6	85×140	3167	—	—	—	Mag.	Solex ...	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	11 2	—	15 2	—	8 8	8 0	815×105
*15-38 Alda (*4*) (sporting) ,,	6	85×140	3167	£450	£550	2	Mag.	Claudel..	Leather cone	4	Bevel	Wire, F.	Fixed ..	10 0	—	14 0	—	7 0	6 10	815×105

* A.C. price includes hood, screen, and lamps. * Ace price includes hood, screen, lamps, and horn. * Price of two-cylinder Adams includes hood, screen, lamps, and horn; an engine starter is included in the prices of the four-cylinder model. * Solid tyres can be fitted to the rear wheels of all Albion models if desired. * 15-38 h.p. sporting type Alda is fitted with the Claudel racing carburetter.

The Autocars of 1914.—

H.P., Name of Car, Number of Cylinders, and Country of Origin.	Tax in Gns.	Bore and Stroke.	Cubic Capacity.	Price. Chassis with tyres.	Price. Car Complete.	No. of Seats.	Ignition	Carburetter.	Clutch.	No. of Gears	Final Drive.	Wheels.	Rims.	Wheelbase.	Track	Extreme Length	Road Clearance.	Length of Body. Space.	Dash to Back Wheel Centre	Tyres.
		mm.	c.c.											ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	mm.
8-10 Alldays (2) (Midget) Eng'd	3	86 × 92	1069	£119	£130	2	Mag.	—	Leather cone	3	Worm	Wire, F.	Fixed	7 0	4 0	9 5	7¾	—	—	650 × 65
10 Alldays (4) (Midget) ,,	3	59 × 100	1094	£145	£158	2	Mag.	—	Leather cone	3	Worm	Wire, F.	Fixed	7 9	4 0	10 2	7¾	—	—	700 × 80
*12-14 Alldays (4) ,,	4	76 × 120	2174	£250	£350	—	Mag.	—	Leather cone	4	Bevel	Wd. or wi., D.	Fixed	9 3½	4 3	12 6	8½	7 3¼	6 7½	810 × 90
16-20 Alldays (4) ,,	6	86 × 130	3012	£280	£400	5	Mag.	—	Leather cone	4	Bevel	Wd. or wi., D.	Fixed	10 0	4 6	13 0	8½	8 0	7 4	815 × 105
25-30 Alldays (4) ,,	6	100 × 130	4082	£340	£430	7	Mag.	—	Leather cone	4	Bevel	Wood, D.	Fixed	10 6	4 6	14 0	8¾	9 4	8 0	820 × 120
*10 Arden (2) England	3	86 × 95	1104	£125	£145	2 to 3	Mag.	Solex	Leather cone	3	Bevel	Wire, F.	Fixed	7 6	3 8	10 4	8½	6 5	5 5	650 × 75
*10 Arden (4) ,,	3	59 × 100	1094	£140	£160	2 to 3	Mag.	Sthenos	Leather cone	3	Bevel	Wire, F.	Fixed	7 6	3 8	10 4	8½	6 5	5 5	700 × 80
*12-18 Argyll (4) (poppet) Scotl'd	4	72 × 120	1953	£280	£335	4	Mag.	Zenith	Multiple disc	4	Worm	Wood, D.	Fixed	9 0	4 3	12 4	7	7 7	6 10	765 × 105
*15-30 Argyll (4) (sleeve) ,,	4	80 × 130	2610	£425	£495	5	Mag.	Zenith	Multiple disc	4	Worm	Wire, D.	Fixed	9 10	4 5	13 6	8	8 3½	7 3½	815 × 105
*25-50 Argyll (4) (sleeve) ,,	6	100 × 130	4082	£590	£675	5	Dual	Zenith	Multiple disc	4	Worm	Wire, D.	Fixed	10 6	4 8½	14 3	8½	8 5½	7 5½	880 × 120
*12 Ariel (4) England	4	76 × 110	1996	£255	£280	2 to 4	Mag.	Zenith	Leather cone	3	Bevel	Wood, F.	Fixed	8 3	4 0	11 8	7	6 11	6 0	760 × 90
*16 Ariel (4) ,,	4	80 × 150	3012	£350	£375	2 to 7	Mag.	Zenith	Leather cone	4	Bevel	Wood, F.	Fixed	10 3	4 6	14 0	8	8 3	7 1	815 × 105
*25 Ariel (4) ,,	6	100 × 130	4082	£450	£495	2 to 7	Dual	W. & P.	Leather cone	4	Bevel	Wood, F.	Fixed	9 8	4 6	13 9	8	8 2	7 0	880 × 120
*10-12 Aries (4) France	3	65 × 100	1327	£235	£280	3	Mag.	Zenith	Multiple disc	3	Bevel	Wd. or wi., F.	Fixed	8 1	3 8	11 6	9	7 0	6 0	710 × 90
*12-16 Aries (4) ,,	4	75 × 140	2474	£296	£400	5	Mag.	Zenith	Multiple disc	3	Bevel	Wd. or wi., F.	Fixed	9 9	4 2	13 9	9½	8 6	7 4	815 × 105
*12-16 Aries (4) ,,	4	75 × 140	2474	£320	£425	5	Mag.	Zenith	Multiple disc	4	Bevel	Wd. or wi., F.	Fixed	9 9	4 2	13 9	9½	8 6	7 4	815 × 105
*16-20 Aries (4) ,,	6	84 × 150	3325	£425	£525	5	Mag.	Zenith	Multiple disc	4	Bevel	Wd. or wi., F.	Fixed	10 4	4 4	14 4	10	8 10	7 6	880 × 120
*20-30 Aries (4) (valveless) ,,	6	101 × 140	4487	£575	£700	5	Mag.	Zenith	Multiple disc	4	Bevel	Wire, F.	Fixed	10 6	4 6	14 8	10	8 10	7 6	880 × 120
15-20 Armstrong-Whit. (4) Eng.	4	80 × 135	2710	£375	—	—	Dual	Zenith	Multiple disc	4	Worm	Wire, D.	Fixed	9 8	4 8	13 6	8½	8 2½	7 1	815 × 105
15-20 Armstrong-W. (4) (Col.) ,,	4	80 × 135	2710	£375	—	—	Dual	Zenith	Multiple disc	4	Worm	Wire, D.	Fixed	9 8	4 8	13 6	11	8 2½	7 1	915 × 105
17-25 Armstrong-Whit. (4) ,,	6	85 × 135	3051	£435	—	—	Dual	Zenith	Multiple disc	4	Worm	Wire, D.	Fixed	9 8	4 8	13 6	8½	8 2½	7 1	820 × 120
17-25 Armstrong-W. (4) (Col.) ,,	6	85 × 135	3051	£435	—	—	Dual	Zenith	Multiple disc	4	Worm	Wire, D.	Fixed	9 8	4 8	13 6	11	8 2½	7 1	915 × 105
17-25 Armstrong-W. (4) (long) ,,	6	85 × 135	3051	£445	—	—	Dual	Zenith	Multiple disc	4	Worm	Wire, D.	Fixed	10 6	4 8	14 4	8½	9 0½	7 11	820 × 120
20-30 Armstrong-Whit. (4) ,,	6	90 × 150	3817	£500	—	—	Dual	Zenith	Multiple disc	4	Worm	Wire, D.	Fixed	10 6	4 8	14 2½	8½	8 9½	7 8	820 × 120
30-50 Armstrong-Whit. (6) ,,	8	90 × 150	5724	£850	—	—	Dual	Zenith	Multiple disc	4	Worm	Wire, D.	Fixed	11 9	4 8	15 8	9	8 11½	7 11	895 × 135
*11.9 Arrol-Johnston (4) Scotland	3	69 × 120	1795	£260	£285	2 or 4	Mag.	Sthenos	Plate	4	Bevel	Wood, D.	Fixed	9 4	4 8	12 10	8½	7 6¼	6 10	760 × 90
*15.9 Arrol-Johnston (4) ,,	4	80 × 120	2409	£320	£360	2 or 4	Mag.	Zenith	Plate	4	Bevel	Steel, D.	Fixed	9 4	4 7	12 10	8½	7 6¼	6 10	815 × 105
*20.9 Arrol-Johnston (4) ,,	6	92 × 140	3723	£350	£400	2	Mag.	Zenith	Plate	4	Bevel	Steel, D.	Fixed	10 3	4 8	12 3	8½	8 9	7 6¾	820 × 120
*20.9 Arrol-Johnston (4) ,,	6	92 × 140	3723	£350	£425	5	Mag.	Zenith	Plate	4	Bevel	Steel, D.	Fixed	10 3	4 8	13 3	8½	8 9	7 6¾	820 × 120
10 Austin (4) (short) England	4	76 × 89	1616	£260	£330	4	Mag.	Claudel	Cone	4	Bevel	Wood, D.	Fixed	8 3	4 0	11 3	9	6 11¾	6 3¾	810 × 90
10 Austin (4) (long) ,,	4	76 × 89	1616	£260	£330	4	Mag.	Claudel	Cone	4	Bevel	Wood, D.	Fixed	9 0	4 0	12 0	9	7 8¼	7 0¾	810 × 90
20 Austin (4) (short) ,,	6	89 × 127	3168	£375	£460	5	M. Acc.	Claudel	Cone	4	Bevel	Steel, D.	Fixed	9 4	4 6	—	9¾	—	—	815 × 105
20 Austin (4) (medium) ,,	6	89 × 127	3168	£375	£460	5	M. Acc.	Claudel	Cone	4	Bevel	Steel, D.	Fixed	9 8	4 6	12 11	9¾	7 11	7 3	815 × 105
20 Austin (4) (long) ,,	6	89 × 127	3168	£390	£480	5	M. Acc.	Claudel	Cone	4	Bevel	Steel, D.	Fixed	10 0	4 6	13 3	9¾	8 3	7 7	815 × 105
30 Austin (4) (short) ,,	8	111 × 152	5883	£550	£640	5	M. Acc.	Claudel	Cone	4	Bevel	Steel, D.	Fixed	10 9	4 7	14 3	9	8 4½	7 9½	895 × 135
30 Austin (4) (long) ,,	8	111 × 152	5883	£575	£700	5	M. Acc.	Claudel	Cone	4	Bevel	Steel, D.	Fixed	11 6	4 7	15 0	9	9 1½	8 6½	895 × 135
16-18 Austro-Daimler (4) Austria	4	80 × 110	2208	£385	—	—	Mag.	Own	Multiple disc	4	Bevel	Wire, D.	Fixed	9 10	4 1	13 2	8	8 4	7 5½	815 × 105
16-25 A.-D. (4) (Alpine) ,,	4	80 × 110	2208	£425	—	—	Mag.	Own	Multiple disc	4	Bevel	Wire, D.	Fixed	9 3	4 1	12 10	8	7 8	6 6½	815 × 105
20-30 Austro-Daimler (4) ,,	6	90 × 140	3561	£540	—	—	Dual	Own	Multiple disc	4	Bevel	Wire, D.	Fixed	10 2	4 7	14 0	9	8 10	7 4	820 × 120
25-35 Austro-Daimler (4) ,,	8	105 × 130	4503	£570	—	—	Mag.	Own	Multiple disc	4	Bevel	Wood, F.	Fixed	10 2	4 4	14 0	9	8 6	7 4	880 × 120
35-60 Austro-Daimler (4) ,,	10	120 × 154	6960	£785	—	—	M. Acc.	Own	Multiple disc	4	Bevel	Sankey, D.	Fixed	11 0	4 9	15 0	8	8 10	7 8	935 × 135
*27-80 A.-D. (4) (short) ,,	8	105 × 165	5709	£850	—	—	—	Own	Multiple disc	4	Bevel	Wire, D.	Fixed	9 10	4 4	13 6	8	7 10	7 11	820 × 120
*27-80 A.-D. (4) (long) ,,	8	105 × 165	5709	£875	—	—	—	Own	Multiple disc	4	Bevel	Wire, D.	Fixed	10 6	4 4	14 2	8	8 6	8 7	820 × 120
Autocrat (2) England	3	86 × 95	1104	£126	£142	2	Mag.	Solex	Multiple disc	3	Bevel	Wire, F.	Fixed	7 6	3 9	10 3	9	6 3	5 0	700 × 65
Autocrat (4) ,,	3	59 × 100	1094	£147	£168	2	Mag.	Zenith	Multiple disc	3	Bevel	Wire, F.	Fixed	7 6	3 9	10 3	9	6 3	5 0	700 × 65
*10 Averies (4) France	3	59 × 100	1094	£135	£158	2	Mag.	Claudel	Leather cone	3	Worm	Wire, F.	Fixed	7 10	3 9	10 11	8	—	—	650 × 65

* Chassis price of 12-14 h.p. Alldays does not include tyres. * Arden prices include hood, screen, and set of oil lamps. * Argyll complete car prices include one-man hood, screen, three lamps, horn, petrol gauge, spare wheel and tyre, number-plates, and concealed wells for spare petrol and oil. * Ariel prices (both chassis and car) include three lamps, horn, and jack; Colonial model Ariels, with 11in. clearance, £10 extra on above prices. * Claudel carburetter can be fitted to Aries cars. * Prices for two-seated Arrol-Johnston cars include a dickey seat; all models are complete with hood, screen, horn, spare wheel, and tyre; the 11.9 h.p. car has acetylene and oil lamps; the 15.9 h.p. and 20.9 h.p. are fitted with complete electric lighting, including lamps and an electric engine starting installation; price of the Arrol-Johnston electric coupe £550. * Both 27-80 h.p. Austro-Daimlers are known as Prince Henry models, and they are fitted with two separate magnetos, one in each case being dual. *Averies chassis price does not include tyres.

The Autocars of 1914.—

H.P., Name of Car, Number of Cylinders, and Country of Origin.	Tax in Gns.	Bore and Stroke.	Cubic Capacity.	Price. Chassis with tyres.	Price. Car Complete.	No. of Seats.	Ignition	Carburetter.	Clutch.	No. of Gears	Final Drive.	Wheels.	Rims.	Wheel-base.	Track.	Extreme Length	Road Clearance.	Length of Body Space.	Dash to Back Wheel Centre	Tyres.
		mm.	c.c.											ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	mm.
15-20 Baguley (4) ..... England	6	90 × 130	3307	£360	—	—	Mag.	Zenith ..	Cone	4	Bevel	Wood, F. ...	Fixed ..	9 6	4 4¾	12 8	10	7 9	6 8	815 × 105
15-20 Baguley (4) (lan'let) ,,	6	90 × 130	3307	£370	—	—	Dual	Zenith ..	Plate	4	Worm	Wood, F. ...	Fixed ..	10 6	4 4¾	13 8	10	8 9	7 8	815 × 105
15-20 Baguley (4) (Col.) ,,	6	90 × 130	3307	£385	—	—	Dual	Zenith ..	Plate	4	Worm	Sankey, D. ..	Fixed ..	10 3	5 0	13 8	11½	8 9	7 5¼	915 × 105
* 8 Bayard (4) .... France ..	3	60 × 120	1360	—	£232	2	Mag.	Solex ...	Leather cone	3	Bevel	Wire, F.	Fixed ..	7 5	3 11	10 0	—	5 7	—	700 × 75
*10 Bayard (4) .... ,,	3	65 × 120	1593	—	£300	4	Mag.	Solex ...	Leather cone	3	Bevel	Sankey, D. ..	Fixed ..	8 3	4 1½	12 0	—	6 7	—	750 × 85
11 Bayard (4) .... ,,	4	75 × 110	1940	£253	—	—	Mag.	Solex ...	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	8 9¾	4 1½	12 1	—	7 6¾	—	810 × 90
*12 Bayard (4) .... ,,	4	70 × 130	2001	—	£350	4	Mag.	Solex ...	Leather cone	4	Bevel	Sankey, D. ..	Fixed ..	9 3	4 4	12 8	—	7 1½	—	760 × 90
*14 Bayard (4) .... ,,	4	80 × 130	2610	£305	£385	4	Mag.	Solex ...	Leather cone	4	Bevel	Sankey, D. ..	Fixed ..	9 9½	4 2	13 0	—	8 0½	—	810 × 90
18 Bayard (4) .... ,,	6	90 × 140	3561	£370	—	4	Mag.	Solex ...	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	11 2	4 7	14 8	—	8 10	—	815 × 105
20 Bayard (4) .... ,,	6	100 × 140	4396	£404	—	4	Mag.	Solex ...	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	11 0	4 7	15 10	—	8 10	—	875 × 105
*15-18 Bedford-Buick (4) U.S.A.	6	95 × 95	2693	—	£285	3	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Baker ..	8 9	4 8	12 6	10½	7 2	6 4½	810 × 90
*15-18 Bedford-Buick (4) ,,	6	95 × 95	2693	—	£295	5	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Baker ..	8 9	4 8	12 6	10½	7 2	6 4½	810 × 90
*15-18 Bedford-Buick (4) ,,	6	95 × 95	2693	—	£365	3	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Baker ..	8 9	4 8	12 6	10½	7 2	6 4½	810 × 90
*18-22 Bedford-Buick (4) ,,	6	102 × 102	3328	—	£350	5	Mag.	Schebler	Leather cone	3	Bevel	Wood, F. ...	Baker ..	9 0	4 8	13 0	9½	7 2	6 4½	810 × 90
*18-22 Bedford-Buick (4) ,,	6	102 × 102	3328	—	£400	3	Mag.	Schebler	Leather cone	3	Bevel	Wood, F. ...	Baker ..	9 0	4 8	13 0	9½	7 2	6 4½	810 × 90
*16 Bell (4) (short) ..... England	6	91 × 120	3122	£325	—	4	Mag.	Own	Plate	3	Bevel	Sankey, D. ..	Fixed ..	8 6	4 8	12 0	8	7 8	6 5¼	810 × 90
*16 Bell (4) (long) ..... ,,	6	91 × 120	3122	£325	—	4	Mag.	Own	Plate	3	Bevel	Sankey, D. ..	Fixed ..	9 6	4 5	13 3	8	7 8	6 11	815 × 105
*20 Bell (4) (short) ..... ,,	6	102 × 140	4576	£400	—	4 or 5	Mag.	Own	Plate	3	Bevel	Sankey, D. ..	Fixed ..	9 6	4 5	13 3	8	7 6	6 9	820 × 120
*20 Bell (4) (long) ..... ,,	6	102 × 140	4576	£400	—	4 or 5	Mag.	Own	Plate	3	Bevel	Sankey, D. ..	Fixed ..	10 3	4 5	14 0	8	8 4¼	7 4⅝	820 × 120
*30 Bell (4) .... ,,	8	115 × 150	6232	£475	—	5	Mag.	Own	Plate	3	Bevel	Sankey, D. ..	Fixed ..	10 3	4 5	14 0	9¼	8 3¼	7 3⅝	880 × 120
10-12 Belsize (4) ...... England	3	69 × 130	1944	£190	£215	2	Mag.	Sthenos .	Metal	3	W or B	Steel, D.	Fixed ..	8 1	4 3	11 3	9½	7 3¼	5 10¼	810 × 90
10-12 Belsize (4) ...... ,,	3	69 × 130	1944	£195	£240	4	Mag.	Sthenos .	Metal	3	W or B	Steel, D.	Fixed ..	8 7	4 3	11 8	9½	7 5¼	6 6½	810 × 90
15.9 Belsize (4) .... ,,	4	80 × 150	3012	£265	£325	2	Mag.	Sthenos .	Metal	4	W or B	Steel, D.	Fixed ..	9 6	4 3	12 9	8	8 3¼	7 3	815 × 105
15.9 Belsize (4) .... ,,	4	80 × 150	3012	£265	£350	4	Mag.	Sthenos .	Metal	4	W or B	Steel, D.	Fixed ..	9 6	4 3	12 9	8	8 3¼	7 3	815 × 105
18-22 Belsize (6) ...... ,,	8	93 × 120	4891	£375	£460	5	M. Acc.	Sthenos .	Metal	4	W or B	Steel, D.	Fixed ..	10 0	4 8¼	13 3	10	8 0½	6 10	820 × 120
12-20 Benz (4) .... Germany	4	72 × 120	1953	£325	—	—	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 4½	4 2	—	8	—	—	815 × 105
15-25 Benz (4) .... ,,	4	80 × 130	2610	£450	—	—	Dual	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 5	4 8	—	8	—	—	820 × 120
28-35 Benz (4) .... ,,	6	95 × 140	3964	£625	—	—	Dual	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 6	4 8	—	8	—	—	880 × 120
35-45 Benz (4) .... ,,	10	120 × 144	9744	£775	—	—	Dual	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	11 1	4 8½	—	8	—	—	895 × 135
40-65 Benz (4) .... ,,	21	130 × 160	8495	£950	—	—	Dual	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	11 1	4 8½	—	8	—	—	895 × 135
100 Benz (4) .... ,,	21	130 × 190	10080	£1150	—	—	Dual	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	11 5	4 9½	—	8	—	—	895 × 135
14-18 Benz-Sohne (4) .. Germany	4	75 × 120	2094	—	—	4	Mag.	Zenith ..	Leather cone	4	Bevel	—	—	10 0	4 4	—	—	8 8	—	810 × 90
17-22 Benz-Sohne (4) .. ,,	6	85 × 115	2608	—	—	4	Mag.	Zenith ..	Leather cone	4	Bevel	—	—	9 8	4 6	13 6	9	8 4	7 1	820 × 120
20-30 Benz-Sohne (4) .. ,,	6	90 × 140	3561	—	—	4	Dual	Zenith ..	Leather cone	4	Bevel	—	—	10 6	4 6	14 6	9	9 2	7 11	820 × 120
12 Berliet (4) .... France ..	4	70 × 100	1539	£285	—	—	Mag.	Own	Multiple disc	4	Bevel	Wd. or wi., F.	Fixed ..	9 1	4 5	12 4	—	8 1	5 3	760 × 90
15 Berliet (4) .... ,,	4	80 × 120	2409	£370	—	—	Mag.	Own	Multiple disc	4	Bevel	Wd. or wi., F.	Fixed ..	9 7	4 5	13 2	—	8 1	5 8	815 × 105
*18 Berliet (4) .... ,,	6	90 × 140	3561	£460	—	—	Mag.	Own	Multiple disc	4	Bevel	Wd. or wi., F.	Fixed ..	10 4	4 10	14 10	—	8 3	5 10	880 × 120
*25 Berliet (4) .... ,,	6	100 × 140	4396	£495	—	—	Mag.	Own	Multiple disc	4	Bevel	Wd. or wi., F.	Fixed ..	10 4	4 10	14 10	—	8 3	5 10	880 × 120
25 Berliet (4) (sporting) ,,	6	100 × 140	4396	£550	—	—	—	—	—	4	Bevel	—	Fixed ..	—	—	—	—	—	—	—
40 Berliet (4) .... ,,	10	120 × 140	6333	£650	—	—	Mag.	Own	Multiple disc	4	Bevel	Wd. or wi., F.	Fixed ..	12 6	4 10	16 4	—	9 6	6 5	880 × 120
*40 Berliet (4) (de luxe) ,,	10	120 × 140	6333	£950	—	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—
*12-18 Bianchi (4) ..... Italy ...	4	75 × 120	2116	£325	£400	—	Mag.	Zenith ..	Multiple disc	4	Bevel	Riley, D.	—	9 3	4 7	13 6	9	7 11	—	765 × 105
*18-24 Bianchi (4) ..... ,,	6	90 × 115	2928	£400	£500	—	Dual	Zenith ..	Multiple disc	4	Bevel	Riley, D.	—	10 2	4 7	15 0	8	8 4	—	815 × 105
*20.1 Bianchi (4) ...... ,,	6	90 × 130	3307	£450	£550	—	Dual	Zenith ..	Multiple disc	4	Bevel	Riley, D.	—	10 3	4 7	15 0	9	8 6	—	820 × 120

* The 8, 10, 12, and 14 h.p. Bayards are supplied complete with one-man type hood (the 10 h.p. has an ordinary type of hood), screen, five lamps, and spare Sankey wheel and tyre (the latter are not included in the price of the 8 h.p. car). * Prices of Bedford-Buick chassis include five lamps, horn, speedometer, wing and step irons, and spare rim; complete car prices include, in addition, hood, screen, and number-plates; the two Arcadian models (those priced at £365 and £400) are fitted with dickey seats. * Bell cars can be supplied with four speeds at an extra cost of £12 10s.; the 16 h.p. (long) and the 20 h.p. (long) chassis are supplied with a 10in. clearance for Colonial use. * 18 h.p. and 25 h.p. Berliets are also supplied with an 11ft. 4in. wheelbase; price of the 40 h.p. de Luxe model includes dynamo lighting set, and electric engine-starter. *All Bianchi cars can be fitted with either Riley detachable wire wheels, or artillery wheels with Michelin detachable rims.

The Autocars of 1914.—

H.P., Name of Car, Number of Cylinders, and Country of Origin.	Tax in Gns.	Bore and Stroke.	Cubic Capacity.	Price. Chassis with tyres.	Price. Car Complete.	No. of Seats.	Ignition	Carburetter.	Clutch.	No. of Gears	Final Drive.	Wheels.	Rims.	Wheel-base.	Track.	Extreme Length	Road Clearance.	Length of Body Space.	Dash to Back Wheel Centre	Tyres.
		mm.	c.c.											ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	mm.
*25-40 Bianchi (4) ..... Italy	6	100×140	4396	£550	£650	—	Dual	Zenith ..	Multiple disc	4	Bevel	Riley, D.	—	11 0	4 10	16 6	9	9 0	—	880×120
*60-70 Bianchi (4) ..... ,,	21	130×150	7964	£800	£900	—	Mag.	Zenith ..	Multiple disc	4	Chain	Riley, D.	—	11 0	4 10	16 10	12	8 8	—	920×120
*12-15 Bozier (4) ...... France..	4	70×130	2001	£228	—	—	Mag.	Solex ...	Leather cone	3	Bevel	Wd. or wi., F.	Fixed ..	9 9	4 4	—	8	7 6	6 6	760×90
14-18 Bozier (4) ...... ,,	4	76×130	2359	£277	—	—	Mag.	Solex ...	Leather cone	4	Bevel	Wd. or wi., F.	Fixed ..	10 0½	4 4	—	9½	8 2½	7 0½	815×105
14-18 Bozier (4) (Colonial) ,,	4	76×130	2359	£290	—	—	Mag.	Solex ...	Leather cone	4	Bevel	Wd. or wi., F.	Fixed ..	10 0½	4 8	—	11¾	8 2½	7 0½	875×105
20-30 Bozier (4) ...... ,,	6	90×140	3561	£375	—	—	Mag.	Solex ...	Leather cone	4	Bevel	Wd. or wi., F.	Fixed ..	11 2	4 8	—	9½	8 8½	7 4½	880×120
20-30 Bozier (4) (Colonial) ,,	6	90×140	3561	£385	—	—	Mag.	Solex ...	Leather cone	4	Bevel	Wd. or wi., F.	Fixed ..	11 2	4 8	—	11¾	8 8½	7 4½	920×120
10 Brasier (2) .... France..	3	90×120	1527	£200	—	—	Mag.	Own	Leather cone	3	Bevel	Wood, F. ...	Detach.	8 3	3 11	11 10	6⅝	6 11	6 2	760×90
11 Brasier (4) .... ,,	3	67×110	1552	£246	£320	4	Mag.	Long'mre	Leather cone	4	Worm	Wood, F. ...	Detach.	8 10½	4 3½	12 7½	6⅝	7 2½	6 2	760×90
12 Brasier (4) .... ,,	4	70×130	2001	£310	£395	4	Mag.	Long'mre	Leather cone	4	Bevel	Wood, F. ...	Detach.	9 10	4 5	13 3½	6⅝	7 6½	6 11½	815×105
*16 Brasier (4) .... ,,	6	85×140	3167	£400	£575	4	Mag.	Own	Leather cone	4	Bevel	Wood, F. ...	Detach.	10 4	4 7	13 11¼	8	8 6½	7 2½	875×105
*22 Brasier (4) .... ,,	6	100×150	4704	£596	£760	4	Mag.	Own	Leather cone	4	Bevel	Wire, D.	Fixed ..	10 10½	4 9	14 9½	6¾	8 10¼	7 9½	880×120
*30 Brasier (4) .... ,,	10	120×150	6786	£676	£840	4	Mag.	Own	Leather cone	4	B or C	Wire, D.	Fixed ..	11 3½	4 9	15 3	—	8 10¼	—	920×120
*24 Brasier (6) .... ,,	8	90×140	5342	£676	£840	4	Mag.	Own	Leather cone	4	Bevel	Wire, D.	Fixed ..	11 8½	4 9	15 7	6¾	8 10¼	7 9½	880×120
Brennabor (4) .. Germany	3	68×100	—	—	£185	3	Mag.	Own	Leather cone	3	Bevel	Wood, F.....	—	8 6	4 0	11 0	8	—	—	700×85
12-20 Brennabor (4) .. ,,	4	70×102	1570	£240	£265	2	Mag.	Own	Leather cone	3	Bevel	Steel, F.	Kronprinz	9 2	4 3	11 9	8	7 6	6 5	760×90
12-20 Brennabor (4) .. ,,	4	70×102	1570	£240	£285	4	Mag.	Own	Leather cone	3	Bevel	Steel, F.	Kronprinz	9 2	4 3	12 5	8	7 6	6 5	760×90
15.9-22 Brennabor (4) . ,,	4	80×102	2051	£300	£340	4–5	Mag.	Own	Leather cone	4	Bevel	Steel, F.	Kronprinz	9 10	4 10	13 8	8	8 0	6 11½	810×90
16.9-28 Brennabor (4) . ,,	6	82×123	2598	£390	£450	4–7	Mag.	Own	Leather cone	4	Bevel	Steel, F.	Kronprinz	10 6	4 10	15 0	8	8 10	7 5	815×105
*10 Briton (4) (special) . England	3	68×120	1743	£168	£184	2	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	8 1	4 3	11 6	6	6 1½	5 3½	700×85
*10 Briton (4) (special) . ,,	3	68×120	1743	£168	£210	4	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	8 6	4 3	12 0	6	7 0	6 1	700×85
*10 Briton (4) (standard) ,,	3	68×120	1743	£200	£247	2	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, D. ...	Fixed ..	9 0	4 6	12 7	7	7 0	5 10½	760×90
*10 Briton (4) (standard) ,,	3	68×120	1743	£200	£268	4	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, D. ...	Fixed ..	9 3	4 6	12 9	7	8 0	6 1	760×90
*14 Briton (4) (special) . ,,	4	80×120	2409	£189	£210	2	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	8 10	4 3	12 0	7	6 11	6 1	760×90
*14 Briton (4) (special) . ,,	4	80×120	2409	£189	£231	4	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	9 8	4 3	12 6	7	6 11	6 1	760×90
*14 Briton (4) (standard) ,,	4	80×120	2409	£236	£326	2	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, D. ...	Fixed ..	8 10	4 8	13 2	8	6 11	5 10½	810×100
*14 Briton (4) (standard) ,,	4	80×120	2409	£236	£368	4	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, D. ...	Fixed ..	9 8	4 8	14 6	8	7 6	6 5	810×100
*13.9 B.S.A. (4) (Knight) England	4	75×114	2015	£250	£325	5	Mag.	Daimler .	Leather cone	3	Worm	Wire, D.	Fixed ..	9 4	4 8½	13 0	10½	6 10	6 9	810×100
* Buchet (4) .... France..	3	60×100	1128	—	£197	2	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	7 6½	3 10	—	—	6 7	—	—
* Buchet (4) .... ,,	4	76×130	2359	£238	£295	3	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	8 10	4 3	12 3	8	7 9	7 0	760×90
* Buchet (4) .... ,,	4	76×130	2359	£238	£329	4	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	8 10	4 3	12 3	8	7 9	7 0	760×90
* Buchet (4) .... ,,	4	76×130	2359	£250	£341	4 or 5	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	9 3	4 3	12 7	8	8 1	—	765×105
* Buchet (4) (landaulet) ,,	4	76×130	2359	£250	£380	—	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	9 3	4 3	12 7	8	8 1	—	765×105
8 Bugatti (4) .... Germany	3	65×100	1327	£265	£300	2	Mag.	Zenith ..	Plate	4	Bevel	Wire, F.	Fixed ..	7 10½	3 9¼	10 6	8	7 0	—	700×85
*15-18 Buick (4) .... U.S.A.	6	95×95	2693	—	£225	2	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Baker ..	8 9	4 8	12 6	10½	7 2	6 4½	810×90
*15-18 Buick (4) .... ,,	6	95×95	2693	£200	£245	5	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Baker ..	8 9	4 8	12 6	10½	7 2	6 4½	810×90
*20-30 Cadillac (4) ..... U.S.A.	8	114×146	5963	£433	£475	5	Cadillac	Own	Leather cone	6	Bevel	Wood, F. ...	Detach.	10 0	4 6	15 4	10	8 2½	6 11¼	880×120
*20-30 Cadillac (4) (long) ..	8	114×146	5963	£458	—	—	Cadillac	Own	Leather cone	6	Bevel	Wood, F. ...	Detach.	11 2	4 6	—	10	9 4½	—	880×120
*10.5 Calcott (4) .... England	3	65×110	1460	£160	£185	2	Mag.	Zenith ..	L'ther to met.	3	Bevel	Sankey, D. ..	Fixed ..	7 6	3 9	10 3	7	6 4	5 6	700×80
*10-12 Calthorpe (4) (Minor) Eng.	3	62×90	1087	—	£168	2	Mag.	Zenith ..	Hele-Shaw .	3	Bevel	Steel, D.	Fixed ..	7 3	3 8	10 6	8	5 4	4 11	700×80
*12-15 Calthorpe (4) ... ,,	3	69×125	1868	—	£299	4	Mag.	Zenith ..	Hele-Shaw .	3	Bevel	Wire, D.	Fixed ..	8 6	4 2	12 0	8	7 1	6 5	760×90
*15 Calthorpe (4) ...... ,,	4	80×150	3012	—	£383	4	Dual	Zenith ..	Hele-Shaw .	4	Bevel	Wire, D.	Fixed ..	9 6	4 6	13 0	8	7 6	6 9	815×105

*All Bianchi cars can be fitted with either Riley detachable wire wheels, or artillery wheels with Michelin detachable rims. * 12-15 h.p. Bozier chassis can be fitted with four speeds, price £238. * The 22, 24, and 30 h.p. Brasiers are fitted with air compressors for pumping tyres; and the 24 and 30 h.p. models have, in addition, automatic engine-starters; Longuemare carburetters can be fitted to the 16, 22, 30, and 24 h.p. models; Brasier complete car prices include hood, screen, and lamps. * All Briton cars are sold complete with hood, screen, three lamps, pump, and horn; the standard models have, in addition, a spare wheel and tyre and head lamps. * B.S.A. complete car price includes hood, screen, horn, and three lamps; with a dynamo lighting set the price is £350, and with an engine-starter, in addition, £365. * Buchet complete car prices include hood and screen; and in the case of the smallest model lamps as well. * Buick chassis price includes five lamps, horn, speedometer, and spare rim; complete car prices include, in addition, hood, screen, and number-plates. * Cadillac cars have (as standard) a special electrical installation for ignition, engine-starting, lighting, and gear changing on the two-speed back axle, the latter providing, with the three-speed box, six forward speeds and two reverse; chassis prices include, in addition to the foregoing, all lamps, speedometer, Manzell tyre pump, electric horn, and spare rim; the complete car price also includes hood and side curtains and screen; detachable rims with detachable flanges are standard. *Calcott complete car price includes hood, screen, five lamps, and horn. *Calthorpe prices include lamps, hood, and screen.

The Autocars of 1914.—

H.P., Name of Car, Number of Cylinders, and Country of Origin.	Tax in Gns.	Bore and Stroke.	Cubic Capacity.	Price: Chassis with tyres.	Price: Car Complete.	No. of Seats.	Ignition	Carburetter.	Clutch.	No. of Gears	Final Drive.	Wheels	Rims.	Wheel-base.	Track.	Extreme Length	Road Clearance.	Length of Body Space.	Dash to Back Wheel Centre	Tyres.
		mm.	c.c.											ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	mm.
*11-15 Chambers (*4*) ... Ireland	4	79 × 102	2000	£245	£295	4	Mag.	Own	Expanding .	3	Worm	Sankey, D. ..	Fixed ..	8 3	4 0	12 3	8	7 0½	6 3	760 × 90
*12-16 Chambers (*4*) ... ,,	6	88 × 102	2481	£285	£345	5	Mag.	Own	Expanding .	3	Worm	Sankey, D. ..	Fixed ..	9 6	4 3	14 0	9	7 10¼	7 0	810 × 100
*35 Chandler (*6*) .... U.S.A.	8	86 × 127	4426	£385	£425	2 to 5	Dual	Stromberg	Multiple disc	3	Bevel	Wood, F. ...	Detach.	10 0	4 8	—	—	—	—	870 × 100
10 Charron (*4*) .... France..	3	65 × 120	1592	£275	£325	2	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	8 6	4 0	12 6	7½	7 0	6 6	750 × 85
15 Charron (*4*) .... ,,	4	80 × 120	2409	£300	£400	3	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	9 4½	4 4¾	13 0	7½	8 0	7 4	815 × 105
15 Charron (*4*) .... ,,	4	80 × 120	2409	£300	£450	5	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	9 4½	4 4¾	13 0	7½	8 0	7 4	815 × 105
15 Charron (*4*) (long) .. ,,	4	80 × 120	2409	£315	£415	3	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 4½	4 9	13 0	7½	8 6	7 4	815 × 105
15 Charron (*4*) (long) .. ,,	4	80 × 120	2409	£315	£465	5	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 4½	4 9	13 0	7½	8 6	7 4	815 × 105
22 Charron (*4*) .... ,,	6	95 × 130	3680	£445	£550	3	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 6	4 9	15 0	8½	8 6	8 0	880 × 120
22 Charron (*4*) .... ,,	6	95 × 130	3680	£445	£600	5	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 6	4 9	15 0	8½	8 6	8 0	880 × 120
30 Charron (*4*) .... ,,	8	110 × 150	5702	£580	£700	3	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 6	4 9	15 6	8½	8 6	8 3	880 × 120
30 Charron (*4*) .... ,,	8	110 × 150	5702	£580	£730	5	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 6	4 9	15 6	8½	8 6	8 3	880 × 120
* 8 Chater-Lea (*2*) (air-c'd) Eng.	3	85 × 85	964	—	£120	2	Mag.	B. & B. ..	Leather cone	3	Worm	Wire, F.	Fixed ..	7 6	3 10	—	10	—	—	650 × 65
10 Chater-Lea (*4*) ..... ,,	3	59 × 100	1094	—	£165	2	Mag.	Zenith ..	Disc	3	Worm	Wire, F.	Fixed ..	—	—	—	—	—	—	700 × 80
10 Chénard-Walcker (*4*) France	3	65 × 120	1592	£185	£225	2	Mag.	Claudel..	Leather cone	3	Bevel	Wood, D. ...	Fixed ..	8 6	4 0	11 0	8½	6 4	5 8	700 × 85
10 Chénard-Walcker (*4*) ,,	3	65 × 120	1592	£200	£265	5	Mag.	Claudel..	Leather cone	3	Bevel	Wood, D. ...	Fixed ..	9 0	4 0	11 6	8½	6 10	6 0	700 × 85
12-14 Chénard-Walcker (*4*) ,,	3	69 × 130	1944	£245	£295	2	Mag.	Claudel..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	9 5	4 3	12 4	9	7 6	6 8	760 × 90
12-14 Chénard-Walcker (*4*) ,,	3	69 × 130	1944	£245	£325	5	Mag	Claudel..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	9 5	4 3	12 4	9	7 6	6 8	760 × 90
*13-18 Chénard-Walcker (*4*) ,,	4	75 × 150	2651	£285	£335	2	Mag.	Claudel..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	9 8¼	4 4	12 10	9	7 9	6 11	810 × 90
*13-18 Chénard-Walcker (*4*) ,,	4	75 × 150	2651	£285	£365	5	Mag.	Claudel..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	9 8¼	4 4	12 10	9	7 9	6 11	810 × 90
*16-20 Chénard-Walcker (*4*) ,,	4	80 × 150	3012	£310	£360	2	Mag.	Claudel..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	9 8¼	4 4	12 10	9	7 9	6 11	815 × 105
*16-20 Chénard-Walcker (*4*) ,,	4	80 × 150	3012	£310	£390	5	Mag.	Claudel..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	9 8¼	4 4	12 10	9	7 9	6 11	815 × 105
*16-20 Chénard-Walcker (*4*) (long)	4	80 × 150	3012	£345	—	—	Mag.	Claudel..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	10 5	4 6	13 10	9	8 6	7 8	820 × 120
*24-30 Chénard-Walcker (*6*) ..	6	80 × 150	4518	£450	—	—	Mag.	Claudel..	Leather cone	4	Bevel	Wire, D.	Fixed ..	10 5	4 6	13 10	9	8 6	7 8	880 × 120
15.9 Cheswold (*4*) ..... England	4	80 × 130	2610	£340	£400	—	Mag.	Zenith ..	Leather cone	4	Worm	St. or wi., D.	Fixed ..	9 8	4 6½	13 6	9	7 7	6 8⅜	815 × 105
*12-16 Clément (*4*) ..... England	4	75 × 110	1940	£290	£380	5	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	9 0	4 3	12 6	9	7 6	6 7	760 × 90
*16-20 Clément (*4*) ..... ,,	6	90 × 120	3052	£350	£465	5	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	10 0	4 8	13 6	10	8 3	7 4	815 × 105
*25-30 Clément (*4*) ..... ,,	8	107 × 130	4680	£475	£600	5	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	10 6	4 8	14 9	10	8 7½	7 5½	880 × 120
*30-35 Clément (*4*) ..... France..	8	115 × 140	5818	£500	£635	5	Mag.	Zenith ..	Multiple disc	4	Bevel	Wood, F. ...	Fixed ..	10 9	4 8	14 9	10	8 7	7 7	880 × 120
16-20 Cottin-Desgouttes (*4*) F'ce	4	80 × 160	3212	£390	—	—	Mag.	Zenith ..	Multiple disc	4	Bevel	Wood, F. ...	Fixed ..	9 11¼	4 5	13 7½	—	8 5	5 8½	815 × 105
*16-20 C.-Desgouttes (*4*) .... ,,	4	80 × 160	3212	£390	—	—	Mag.	Zenith ..	Multiple disc	4	Chain	Wood, F. ...	Fixed ..	10 1¼	4 5	13 5½	—	8 4¼	5 11¼	815 × 105
*16-20 C.-Desg. (*4*) (sporting) ,,	4	80 × 160	3212	£410	—	—	Mag.	Zenith ..	Multiple disc	4	B or C	Wood, F. ...	Fixed ..	—	—	—	—	—	—	815 × 105
20-30 Cottin-Desgouttes (*4*) ,,	6	100 × 160	5027	£510	—	—	Mag.	Zenith ..	Multiple disc	4	Bevel	Wood, F. ...	Fixed ..	9 11¼	4 5	13 5½	—	8 5	5 10½	880 × 120
*20-30 Cottin-Desgouttes (*4*) ,,	6	100 × 160	5027	£510	—	—	Mag.	Zenith ..	Multiple disc	4	Chain	Wood, F. ...	Fixed ..	9 11¾	4 5	13 5½	—	8 5	5 10½	880 × 120
*20-30 C.-Desg. (*4*) (sporting) ,,	6	100 × 160	5027	£530	—	—	Mag.	Zenith ..	Multiple disc	4	B or C	Wood, F. ...	Fixed ..	—	—	—	—	—	—	880 × 120
*40 Cottin-Desgouttes (*4*) ,,	10	120 × 160	7238	£650	—	—	Mag.	Zenith ..	Multiple disc	4	Chain	Wood, F. ...	Fixed ..	10 0¼	4 7	14 1¼	—	8 4¼	5 5¼	880 × 120
*60 Cottin-Desgouttes (*4*) ,,	21	130 × 200	10618	£810	—	—	Mag.	Zenith ..	Multiple disc	4	Chain	Wood, F. ...	Fixed ..	10 2	4 7	14 3¼	—	7 9	4 11¼	880 × 120
15 Crossley (*4*) (short) . England	4	80 × 120	2409	£350	£430	4	Mag.	Smith ..	Leather cone	4	Bevel	Wi. or st., D.	Fixed ..	9 7	4 6	13 4	7 8½ 10	7 7	6 7	815 × 105
15 Crossley (*4*) (long) .. ,,	4	80 × 120	2409	£370	£460	4	Mag.	Smith ..	Leather cone	4	Bevel	Wi. or st., D.	Fixed ..	10 4	4 6	14 1	7 8½ 10	8 4	7 4	820 × 120
15 Crossley-Shelsley (*4*) (short) ,,	4	80 × 130	2610	£355	£435	4	Mag.	Smith ..	Leather cone	4	Bevel	Wi. or st., D.	Fixed ..	9 7	4 6	13 4	7 8½ 10	7 7	6 7	815 × 105
15 Crossley-Shelsley (*4*) (long) ,,	4	80 × 130	2610	£375	£465	4	Mag.	Smith ..	Leather cone	4	Bevel	Wi. or st., D.	Fixed ..	10 4	4 6	14 1	7 8½ 10	8 4	7 4	820 × 120
15 C.-Shelsley (*4*) (short) (sp'g) ,,	4	80 × 130	2610	£375	£455	4	Mag.	Smith ..	Leather cone	4	Bevel	Wi. or st., D.	Fixed ..	9 7	4 6	13 4	7 8½ 10	7 7	6 7	815 × 105
15 C.-Shelsley (*4*) (long) (sp'g) ,,	4	80 × 130	2610	£395	£485	4	Mag.	Smith ..	Leather cone	4	Bevel	Wi. or st., D.	Fixed ..	10 4	4 6	14 1	7 8½ 10	8 4	7 4	820 × 120
20-25 Crossley (*4*) (short)	6	102 × 140	4576	£475	£575	4	Dual	Smith ..	Leather cone	4	Bevel	Wi. or st., D.	Fixed ..	10 6	4 6	14 10	7 or 9	8 6	7 2	880 × 120
20-25 Crossley (*4*) (long)	6	102 × 140	4576	£500	—	4	Dual	Smith ..	Leather cone	4	Bevel	Wi. or st., D.	Fixed ..	11 3	4 6	15 7	7 or 9	9 3	7 11	895 × 135
Crouch Carette (*2*) . England	3	80 × 90	905	£112	£132	2 or 3	Mag.	Solex ...	Cone	3	Chain	Wood, F. ...	Fixed ..	8 0	4 0	10 0	—	—	—	650 × 65

* Chambers cars are fitted with the Chambers easy starter. * Chandler prices include complete electric lighting and starting system, electric horn, speedometer, petrol gauge, clock, and spare rim; the complete car price includes, in addition, hood and screen; the detachable rims are fitted with detachable flanges. * 8 h.p. Chater-Lea, with water-cooled engine, £137. * These Chénard-Walcker models have double spark magnetos. * Clément complete car prices include hood and screen. * Cottin-Desgouttes chain-driven chassis have direct drive on both third and fourth gears; the engines of the sporting models have four valves per cylinder.

The Autocars of 1914.—

H.P., Name of Car, Number of Cylinders, and Country of Origin.	Tax in Gns.	Bore and Stroke.	Cubic Capacity.	Price. Chassis with tyres.	Price. Car. Complete.	No. of Seats.	Ignition	Carburetter.	Clutch.	No. of Gears	Final Drive.	Wheels.	Rims.	Wheelbase.	Track.	Extreme Length	Road Clearance.	Length of Body Space.	Dash to Back Wheel Centre	Tyres.
		mm.	c.c.											ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	mm.
8 Cumbria (2) .... England	3	85 × 85	964	—	£128	2	Mag.		Leather cone	3	Chain	Wire, F.	Fixed ..	7 6	3 8	10 6	9	6 9	5 9	700 × 75
8-10 Cumbria (4) .... ,,	3	58 × 105	1110	—	£160	2	Mag.	Zenith ..	Leather cone	3	Bevel	Wire, F.	Fixed ..	8 0	3 8	11 0	9	6 9	5 9	700 × 75
10 Cummikar (4) .... France ..	3	62 × 80	964	£172	£185	2	Mag.	Zenith ..	Leather cone	3	Bevel	Wire, F.	Fixed ..	7 4	3 6	10 0	8	5 7	4 10	700 × 85
*20 Daimler (4) (Knight) England	6	90 × 130	3307	£430	£555	5	Mag.	Own	Leather cone	3	Worm	Wire, D.	Fixed ..	10 11	4 8½	14 6	10⅛	8 11	8 2¼	815 × 105
*20 Daimler (4) (Knight) ,,	6	90 × 130	3307	£450	£575	5	Mag.	Own	Leather cone	4	Worm	Wire, D.	Fixed ..	10 11	4 8½	14 6	10⅛	8 11	8 2¼	815 × 105
*30 Daimler (4) (Knight) ,,	8	110 × 130	4942	£625	£795	5	Dual	Own	Leather cone	4	Worm	Wire, D.	Fixed ..	11 3	4 8½	15 8¾	7	9 10¼	8 1⅜	895 × 135
*30 Daimler (6) (Knight) ,,	8	90 × 130	4961	£690	£860	5	Dual	Own	Leather cone	4	Worm	Wire, D.	Fixed ..	11 9½	4 8½	16 3¾	7	9 10¼	8 1⅜	895 × 135
*45 Daimler (6) (Knight) ,,	21	110 × 130	7413	£925	£1175	5	Dual	Own	Leather cone	4	Worm	Wire, D.	Fixed ..	12 2	4 8½	16 8	7	9 10¼	8 1⅜	895 × 135
*12 Darracq (4) .... France ..	4	75 × 120	2116	£240	£310	4	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	9 5	4 1	12 8	8	7 4	6 8	760 × 90
*16 Darracq (4) .... ,,	6	85 × 130	2938	£295	£375	5	Mag.	S.U.	Leather cone	4	Worm	Wood, D. ...	Fixed ..	9 8	4 3¼	13 6	7½	7 8	6 10½	815 × 105
8-10 De Dion Bouton (4) F'nce	3	56 × 120	1184	£221	—	2 to 4	Mag.	Zenith ..	Plate	3	Bevel	Wood, F. ...	Fixed ..	8 7¼	3 9¼	11 10½	7⅝	7 0⅝	3 5¼	750 × 85
12 De Dion Bouton (4) ..	3	66 × 120	1642	£275	—	2	Mag.	Zenith ..	Plate	4	Bevel	Wood, F. ...	Fixed ..	9 5¼	4 1¼	12 10½	6⅞	8 0½	6 11⅝	810 × 90
14 De Dion Bouton (4) ..	4	75 × 130	2298	£310	—	4	Mag.	Zenith ..	Plate	4	Bevel	Wood, F. ...	Fixed ..	9 8¼	4 1¼	13 3	7	8 0½	6 11⅝	815 × 105
14 De Dion Bouton (4) (Col.) ..	4	75 × 130	2298	—	—	4	Mag.	Zenith ..	Plate	4	Bevel	Wood, F. ...	Fixed ..	9 8¼	4 1¼	13 3	9⅞	8 0½	6 11⅝	875 × 105
18 De Dion Bouton (4) ..	4	80 × 140	2811	£372	—	4	Mag.	Zenith ..	Plate	4	Bevel	Wood, F. ...	Fixed ..	11 0	4 5⅛	13 3	8	8 8⅜	7 8⅝	875 × 105
18 De Dion Bouton (4) (Col.) ..	4	80 × 140	2811	—	—	4	Mag.	Zenith ..	Plate	4	Bevel	Wood, F. ...	Fixed ..	11 0	4 5⅛	13 3	11¾	8 8⅜	7 8⅝	920 × 120
25 De Dion B. (4) (Col. only) ..	6	100 × 140	4396	—	—	4	Mag.	Zenith ..	Plate	4	Bevel	Wood, F. ...	Fixed ..	11 6⅝	4 7⅛	15 4¼	11¾	8 8⅜	7 9	920 × 120
24 De Dion Bouton (8) ..	6	66 × 130	3558	£501	—	4	Mag.	Zenith ..	Plate	4	Worm	Wood, F. ...	Fixed ..	10 6	4 5⅛	14 3¾	8	8 8⅜	7 10	880 × 120
30 De Dion Bouton (8) ..	8	75 × 130	4596	£571	—	4	Mag.	Zenith ..	Plate	4	Worm	Wood, F. ...	Fixed ..	11 2½	4 7⅛	15 3½	8	8 11	8 0	935 × 135
50 De Dion Bouton (8) ..	12	94 × 140	7773	£728	—	4	Mag.	Zenith ..	Plate	4	Bevel	Wood, F. ...	Fixed ..	11 10⅜	4 9⅛	16 2½	9¾	9 0¼	8 2¾	1000 × 150
12 Delage (4) .... France ..	3	65 × 110	1460	£248	£288	2 to 4	Mag.	Claudel ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	8 4	4 1	12 0	7	7 6	5 7	760 × 90
14 Delage (4)	4	75 × 130	2298	£308	£352	2	Mag.	Claudel ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 4	4 3	13 7	8	7 9	6 5	815 × 105
14 Delage (4)	4	75 × 130	2298	£318	£388	4	Mag.	Claudel ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 3	4 7	14 3	8	8 6	6 11	815 × 105
15.9 Delage (6)	4	65 × 130	2592	£360	£424	2	Mag.	Claudel ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 8	4 3	13 9	8	7 0	6 0	815 × 105
15.9 Delage (6)	4	65 × 130	2592	£365	£447	4	Mag.	Claudel ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	11 0	4 7	14 11	8	8 6	6 11	820 × 120
*10-12 Delahaye (4) .... France ..	3	65 × 120	1593	£254	—	4	Mag.	Claudel ..	Leather cone	3 or 4	Bevel	Wood, D. ...	Fixed ..	8 10	4 4	12 2	8	7 6½	6 6	760 × 90
*12-16 Delahaye (4)	4	75 × 130	2298	£286	—	5	Mag.	Claudel ..	Leather cone	3 or 4	Bevel	Wood, D. ...	Fixed ..	8 10	4 7	12 7	8	7 6½	7 6	815 × 105
*16-20 Delahaye (4)	6	85 × 130	2938	£390	—	—	Mag.	Claudel ..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	10 0	4 9	13 10	8	8 2½	8 0	880 × 120
*20-30 Delahaye (4)	6	95 × 130	3680	£460	—	4 to 7	Mag.	Claudel ..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	10 2	4 9½	14 2	8	8 6½	8 6	880 × 120
*30-40 Delahaye (4)	8	110 × 150	5702	£625	—	4 to 7	Mag.	Claudel ..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	10 8	4 9½	14 8	9	9 2½	9 0	895 × 135
*18-24 Delahaye (6)	6	75 × 120	3174	£440	—	4 to 7	Mag.	Claudel ..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	10 0	4 9	13 10	8	8 2½	8 0	880 × 120
*17 Delaunay-Belleville (4) F'nce	6	85 × 130	2938	£440	—	—	Mag.	Own	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 9				8 8		815 × 105
*25 Delaunay-Belleville (4) ,,	6	100 × 140	4396	£560	—	—	Mag.	Own	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 6	—	—		9 0	—	880 × 120
*20 Delaunay-Belleville (6) ..	6	78 × 140	4014	£560	—	—	Mag.	Own	Plate	4	Bevel	Wood, F. ...	Fixed ..	10 4½	—			8 9	—	880 × 120
*20 Delaunay-B. (6) (special) ..	6	78 × 140	4014	£600	—	—	Mag.	Own	Plate	4	Bevel	Wood, F. ...	Fixed ..	10 4½			—	8 9	—	880 × 120
*26 Delaunay-Belleville (6) ..	8	85 × 130	4407	£600	—	—	Mag.	Own	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 6		—		9 0	—	880 × 120
*30 Delaunay-Belleville (6) ..	8	88 × 150	5474	£700	—	—	Mag.	Own	Metal disc ..	4	Bevel	Wood, F. ...	Fixed ..	12 0		15 0	—	8 10	—	880 × 120
*35 Delaunay-Belleville (6) ..	8	90 × 150	5724	£740	—	—	Mag.	Own	Plate	4	Bevel	Wood, F. ...	Fixed ..	10 0		—		8 10	—	880 × 120
*37 Delaunay-Belleville (6) ..	10	100 × 140	6594	£740	—	—	Mag.	Own	Plate	4	Bevel	Wood, F. ...	Fixed ..	11 2½				9 2		920 × 120
*45-50 Delaunay-Belleville (6) ..	10	103 × 160	7999	£900	—	—	Mag.	Own	Plate	4	Bevel	Wood, F. ...	Fixed ..	11 8	—	—	—	8 11	—	935 × 135
*12-14 Delta (4) .... France ..	3	68 × 120	1743	£160	£200	2	Mag.	Two-jet .	Leather cone	3	Bevel	Wd. or wire, F	Fixed ..	7 9	4 2	11 0	8	7 5	5 9	700 × 80
*12-14 Delta (4)	3	38 × 120	1743	£170	£235	4	Mag.	Two-jet .	Leather cone	3	Bevel	Wd. or wire, F	Fixed ..	8 5	4 2	11 8	8	8 1	6 5	700 × 80
20 Dennis (4) .... England	6	90 × 130	3307	£390	£480	5	Mag.	W. & P. .	Cone	4	Worm	Wood, F. ...	Fixed ..	10 3½	4 6	14 4	8⅝	8 4	7 5½	815 × 105
24 Dennis (4)	6	100 × 130	4082	£450	£550	7	Mag.	W. & P. .	Cone	4	Worm	Wood, F. ...	Fixed ..	10 3½	4 6	14 4	9⅞	8 4	7 5½	880 × 120

*Daimler chassis prices include complete electric lighting (with all lamps) and electric engine starter; complete car prices include hood, screen, and spare wheel. *Price of complete 12 h.p. Darracq includes hood, screen, five lamps, spare wheel and tyre; chassis price of 16 h.p. Darracq includes a C.A.V. lighting set with lamps, and the complete price a one-man hood, screen, spare wheel and tyre; for covered-in bodies the 16 h.p. model is also made in a longer wheelbase. *Delahaye prices do not include tyres. *Delaunay-Belleville colonial chassis with 10in. clearance, £10 extra on above prices. *Delta complete car prices include hood, screen, and lamps.

The Autocars of 1914.—

H.P., Name of Car, Number of Cylinders, and Country of Origin.	Tax in Gns.	Bore and Stroke.	Cubic Capacity.	Price. Chassis with tyres.	Price. Car Complete.	No. of Seats.	Ignition	Carburetter.	Clutch.	No. of Gears	Final Drive.	Wheels.	Rims.	Wheelbase.	Track.	Extreme Length	Road Clearance.	Length of Body Space.	Dash to Back Wheel Centre	Tyres.
		mm.	c.c.											ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	mm.
*16-20 Detroiter (4) .... U.S.A.	6	86×121	2811	—	£200	5	Mag.	—	Multiple disc	3	Bevel	Wood, F. ...	Detach.	8 8	4 8	—	10½	—	—	810×90
*16-20 Detroiter (4) (special) ,,	6	86×121	2811	-	£235	5	Mag.	—	Multiple disc	3	Bevel	Wood, F. ...	Detach.	8 8	4 8	—	10½	—	—	810×90
*10-12 D.F.P. (4) ...... France..	3	65×120	1593	£235	£275	2	Mag.	Claudel-Z	Leather cone	3	Bevel	Wood, F. ...	Warland	9 0	4 0	11 10	7	6 10	—	750×85
*12-15 D.F.P. (4) ...... ,,	4	70×130	2001	£290	£340	2	Mag.	Claudel-Z	Leather cone	4	Bevel	Wood, F. ...	Warland	9 8	4 3	13 6	7	7 6	—	760×90
*12-15 D.F.P. (4) ...... ,,	4	70×130	2001	£290	£385	4	Mag.	Claudel-Z	Leather cone	4	Bevel	Wood, F. ...	Warland	9 8	4 3	13 6	7	7 6	—	760×90
*12-15 D.F.P. (4) (sporting) ,,	4	70×130	2001	£320	—	—	Mag.	Claudel-Z	Leather cone	4	Bevel	Wire, F.	Warland	9 8	4 3	13 6	7	7 6	—	760×100
*16-22 D.F.P. (4) ,,	4	80×150	3012	£340	£460	4	Mag.	Claudel-Z	Leather cone	4	Bevel	Wire, F.	Warland	10 6	4 6	14 6	8	8 8	—	815×105
*22 Empire (4) .... U.S.A.	6	95×114	3232	£190	£210	4 to 5	Mag.	Holley ..	Disc	3	Bevel	Fixed	Baker ..	9 0	4 8	13 2	10	7 0	6 8	810×90
* 8 Enfield (2) .... England	3	86×92	1069	—	£138	2	Mag.	Zenith ..	Leather cone	3	Worm	Wire, F.	Fixed ..	7 0	4 0	9 3	7	—	—	650×65
* 9 Enfield (4) .... ,,	3	59×100	1094	—	£158	2	Mag.	Zenith ..	Leather cone	3	Worm	Wire, F.	Fixed ..	7 9	4 0	10 0	7	—	—	700×80
*14.3 Enfield (4) .... ,,	4	76×120	2174	£269	£340	2	Mag.	W. & P. .	Leather cone	4	Bevel	Wire or wd., D	Fixed ..	9 3	4 3	13 3	8½	7 7	6 7½	810×90
*14.3 Enfield (4) .... ,,	4	76×120	2174	£269	£350	4	Mag.	W. & P. .	Leather cone	4	Bevel	Wire or wd., D	Fixed ..	9 3	4 3	13 3	8½	7 7	6 7½	810×90
*18.4 Enfield (4) .... ,,	6	86×130	3012	£316	£425	5	Mag.	W. & P. .	Leather cone	4	Bevel	Wire or wd., D	Fixed ..	10 0	4 6	14 0	8½	8 0	7 0	815×105
*24.9 Enfield (4) .... ,,	6	100×130	4082	£371	£480	6	Mag.	W. & P. .	Leather cone	4	Bevel	Wire or wd., D	Fixed ..	10 6	4 6	14 9	8½	9 0	8 0	820×120
18 Ensign (4) .... England	6	85×130	2938	£340	£425	5	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Vinet ...	9 6	4 6	13 5	9	8 4	7 2	815×105
22 Ensign (4) .... ,,	6	95×150	4253	£440	£540	5 or 7	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Vinet ...	10 6	4 6	14 8	9	9 1	7 11	820×120
14-20 Excelsior (4) .... Belgium	6	85×130	2938	£350	£400	5	Mag.	Claudel..	Leather cone	4	Bevel	Wire, D.	Fixed ..	9 11	4 7	13 6	8½	8 4	7 5	815×105
20-30 Excelsior (6) .... ,,	8	85×130	4407	£435	—	5	Mag.	Claudel..	Leather cone	3	Bevel	Wire, D.	Fixed ..	10 8½	4 7	14 4½	8½	8 8	7 9	815×105
*12-15 F.A.B. (4) ...... Belgium	4	75×120	2116	£320	£395	4	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	10 0	4 5	13 9	8½	8 2	7 6	815×105
*20 F.A.B. (4) .... ,,	6	90×140	3561	£410	£490	5	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	11 0	4 7	14 7	8½	8 10	7 9	820×120
*11-16 Fafnir (4) (short) Germany	3	66×114	1560	£200	—	—	Mag.	Pellas ..	Leather cone	3	Bevel	Wire, F.	Fixed ..	7 10½	4 1¼	—	9	6 6¾	—	700×85
*11-16 Fafnir (4) (long) ,,	3	66×114	1560	£210	—	—	Mag.	Pellas ..	Leather cone	4	Bevel	Wire, F.	Fixed ..	8 10¼	4 1¼	—	9	7 8	—	760×90
*12-20 Fafnir (4) ...... ,,	4	72×125	2036	£250	—	—	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	9 1⅛	4 1¼	—	10	7 8	—	810×90
*16-25 Fafnir (4) (short) ,,	4	80×125	2510	£285	—	—	Mag.	Pellas ..	Leather cone	4	Bevel	Wire, D.	Fixed ..	9 8⅛	4 1¼	—	10	8 2⅛	—	815×105
*16-25 Fafnir (4) (long) ,,	4	80×125	2510	£310	—	—	Mag.	Pellas ..	Leather cone	4	Bevel	Wire, D.	Fixed ..	10 2⅛	4 1¼	—	10	8 7¼	—	820×120
*20-35 Fafnir (4) ...... ,,	6	90×140	3561	£425	—	—	Mag.	Pellas ..	Leather cone	4	Bevel	Wire, D.	Fixed ..	11 1⅞	4 7⅞	—	11	9 2¼	—	880×120
*12-15 F.I.A.T. (4) ..... Italy ...	4	70×120	1843	£295	£365	4	Mag.	Own	Multiple disc	4	Bevel	Wood, F. ...	Michelin	8 8⅛	3 11¼	12 9	6	7 1½	6 6	760×90
*15-20 F.I.A.T. (4) ..... ,,	4	80×140	2811	£365	£500	4	Mag.	Own	Multiple disc	4	Bevel	Wood, F. ...	Fixed ..	8 11⅞	4 7⅞	12 10	7	8 1¼	6 10½	815×105
*20-30 F.I.A.T. (4) ..... ,,	6	100×140	4396	£515	£715	4	Mag.	Own	Multiple disc	4	Bevel	Wood, F. ...	Fixed ..	10 3⅝	4 7⅞	14 6	7	8 6½	7 6	880×120
*35 F.I.A.T. (4) .... ,,	8	110×150	5702	£650	£850	4	Mag.	Own	Multiple disc	4	Bevel	Wood, F. ...	Fixed ..	10 3⅝	4 7⅞	14 6	6¾	8 6½	7 6	880×120
12-16 F.L. (4) .... France..	4	80×100	2012	£300	£375	5	Mag.	Claudel..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 3½	4 4½	13 0	7	8 2	6 9	815×105
18-24 F.L. (6) .... ,,	6	80×100	3018	£450	£550	5	Mag.	Claudel..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 6½	4 5	14 1½	7	8 5	6 11	820×120
8-10 F.N. (4) .... Belgium	3	60×110	1245	—	£250	2	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, D. ...	F.N.	7 6	3 9	10 7½	—	—	—	710×90
12-14 F.N. (4) .... ,,	3	69×130	1944	£325	—	—	Mag.	Own	Multiple disc	4	Bevel	Wood, F. ...	F.N.	9 6	4 4	13 4	8½	—	—	815×105
18 F.N. (4) .... ,,	6	85×120	2714	£395	—	—	Mag.	Own	Multiple disc	4	Bevel	Wood, F. ...	F.N.	10 3	4 7	14 6	9	—	—	820×120
20 Ford (4) (runabout) U.S.A.	6	95×102	2892	—	£125	2	Mag.	—	Multiple disc	2	Bevel	Wood, F. ...	Fixed ..	8 4	4 8	—	—	—	—	—
20 Ford (4) (touring) .. ,,	6	95×102	2892	—	£135	5	Mag.	—	Multiple disc	2	Bevel	Wood, F. ...	Fixed ..	8 4	4 8	—	—	—	—	—
20 Ford (4) (town) .... ,,	6	95×102	2892	—	£180	6	Mag.	—	Multiple disc	2	Bevel	Wood, F. ...	Fixed ..	8 4	4 8	—	—	—	—	—
* 8 Forest (2) .... England	3	84×120	1328	£150	£165	2	Dual	Fairhurst	—	—	Bevel	Wood, F. ...	Fixed ..	7 0	4 0	10 0	9	7 0	5 3	710×90
* Foy-Steele (4) ..... England	4	76×127	2305	—	£265	2	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, D. ...	Fixed ..	9 2½	4 2	—	10	—	—	800×85
* Foy-Steele (4) ..... ,,	4	76×127	2305	—	£315	4	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, D. ...	Fixed ..	9 6	4 2	—	10	—	—	810×90

*Detroiter prices include hood, screen, electric lighting set, spare rim, speedometer, and horn; the special model also includes an electric engine starter. *D.F.P. complete car prices include hood, screen, five lamps, and horn. *Empire complete car price includes hood, screen with side curtains, five lamps, speedometer, horn, and number-plates. *8 h.p. and 9 h.p. Enfields are complete with hood, screen, three lamps, and horn; complete prices of other models include spare wheel and tyre, hood, screen, dynamo lighting set with five lamps, and horn. *F.A.B. complete prices include hood, screen, lamps, horn, and spare wheel and tyre; price of the 20 h.p. model also includes a speedometer. *Fafnir chassis prices do not include tyres. *F.I.A.T. complete car prices include hood and screen; the 12-15 h.p. also has five lamps and spare rim and tyre, the 15-20 h.p. three lamps, and the two largest models five lamps. *Forest is friction driven. *Foy-Steele prices include five lamps, horn, hood, and screen.

The Autocars of 1914.—

H.P., Name of Car, Number of Cylinders, and Country of Origin.	Tax in Gns.	Bore and Stroke.	Cubic Capacity.	Price. Chassis with tyres.	Price. Car Complete.	No. of Seats.	Ignition	Carburetter.	Clutch	No. of Gears	Final Drive.	Wheels.	Rims.	Wheelbase.	Track.	Extreme Length	Road Clearance.	Length of Body Space.	Dash to Back Wheel Centre	Tyres
		mm.	c.c.											ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	mm.
13 Germain (4) (Knight) Belgium	4	75×114	2016	£340	—	—	Mag.	Zenith	Leather cone	3	Bevel	Riley, D.	Fixed	9 9	4 1	13 1	—	7 10	—	815×105
15 Germain (4) ,,	4	80×140	2811	£350	—	—	Mag.	Zenith	Leather cone	4	Bevel	Riley, D.	Fixed	10 10	4 3	14 5	—	8 6	—	815×105
20 Germain (4) (Knight) ,,	6	90×130	3307	£425	—	—	M. Acc.	Zenith	Leather cone	4	B or W	Riley, D.	Fixed	11 2½	4 5	14 9	—	8 6	—	880×120
18 Germain (4) ,,	6	102×110	3584	£340	—	—	Mag.	Zenith	Leather cone	3	Bevel	Riley, D.	Fixed	9 9	4 1	13 1	—	7 10	—	815×105
28 Germain (4) (short) ,,	10	120×130	5876	£500	—	—	Mag.	Zenith	Metal exp'g	3	Bevel	Riley, D.	Fixed	10 3	4 1	13 5	—	7 10	—	820×120
28 Germain (4) (long) ,,	10	120×130	5876	£560	—	—	Mag.	Zenith	Metal exp'g	4	Bevel	Riley, D.	Fixed	10 7½	4 9	14 8	—	9 0	—	880×120
*12.1 Gladiator (4) France	4	70×110	1689	£260	£295	2	Mag.	Own	Leather cone	3	Bevel	Wood, F.	Captain	9 2	4 0	12 8	9½	7 8	6 10	760×90
*12.1 Gladiator (4) ,,	4	70×110	1689	£285	£335	4	Mag.	Own	Leather cone	4	Bevel	Dunlop, D.	Fixed	9 2	4 0	12 8	9½	7 8	6 10	760×90
*15.9 Gladiator (4) ,,	4	80×110	2208	£300	£415	4	Mag.	Own	Leather cone	3	Bevel	Wood, F.	Captain	9 3	4 1	13 0	9½	7 8½	6 8½	810×90
*15-20 Gladiator (4) (lan'let) ,,	4	80×130	2610	£345	£465	4	Mag.	Own	Leather cone	4	Bevel	Dunlop, D.	Fixed	9 9	4 5	13 6	9½	8 0½	7 0½	815×105
*15-20 Gladiator (4) (lan'let) ,,	4	80×130	2610	£360	£560	6	Mag.	Own	Leather cone	4	Bevel	Dunlop, D.	Fixed	9 9	4 5	13 6	9½	8 0½	7 0½	820×120
*25-30 Gladiator (4) ,,	6	101×130	4166	£500	£745	6	Mag.	Own	Leather cone	4	Bevel	Dunlop, D.	Fixed	11 0	4 6	14 9	9½	8 10	7 6	835×135
15-20 Gobron (4) France	6	75×150	2651	£395	—	—	Mag.	Own	Leather cone	4	Bevel	Wood, F.	Fixed	10 4	4 4	14 4	10	8 6	7 9	815×105
18 Gobron (sporting) (4) ,,	6	80×160	3212	£450	—	—	Mag.	Own	—	4	Bevel	Wire, D.	—	10 4	4 4	—	—	—	—	820×120
20-30 Gobron (4) ,,	8	90×180	4578	£580	—	—	Mag.	Own	—	4	Bevel	Wood, F.	—	11 3	4 7	15 7	—	9 3	—	880×120
22-40 Gobron (4) ,,	10	100×220	6283	£750	—	—	Mag.	Own	—	4	Bevel	—	—	11 6	4 7	—	—	—	—	880×120
40-50 Gobron (4) ,,	21	110×250	8668	£960	—	—	Mag.	Own	—	4	Bevel	Wood, F.	—	11 9	4 8	15 11	—	9 3	—	935×135
10-12 Goodchild (4) England	3	64×102	1312	—	£195	2 to 3	Mag.	—	Metal exp'g	3	Bevel	Steel, D.	Fixed	8 0	3 10	10 6	8	6 0	5 11	700×85
9 Gordon (2) (air-cooled) Eng.	3	85×95	1074	—	£105	2	Mag.	Own	Plate	2	Chain	Wire, F.	Fixed	7 6	3 8	10 0	6	—	—	650×65
9 Gordon (2) (water-cooled) ,,	3	85×95	1074	—	£121	2	Mag.	Own	Plate	2	Chain	Wire, F.	Fixed	7 6	3 8	10 0	6	—	—	650×65
9 Gordon (2) (water-cooled) ,,	3	85×95	1074	—	£131	4	Mag.	Own	Plate	2	Chain	Wire, F.	Fixed	8 6	3 8	11 0	6	—	—	700×80
10-12 G.R. (4) France	3	65×110	1460	£236	—	—	Mag.	Own	Leather cone	4	Bevel	Wire, F.	Captain	8 6	4 0	11 10	6½	7 0	6 2	760×90
10-14 Grégoire (4) (stand'd) F'ce	3	65×130	1728	£230	—	—	Mag.	Zenith	Leather cone	4	Bevel	Wire, F.	Fixed	9 3	4 1	12 6½	—	7 4	—	760×90
10-14 Grégoire (4) (de luxe) ,,	3	65×130	1728	£295	—	—	Mag.	Zenith	Leather cone	4	Worm	Wood, D.	Fixed	10 4	4 7	—	—	8 6½	—	810×90
*20 Grégoire (4) (sporting) ,,	4	70×140	2155	£340	—	—	Mag.	Zenith	Leather cone	4	Bevel	Wire, D.	Fixed	9 3	4 1	12 6½	—	7 4	—	810×90
14-16 Grégoire (4) ,,	4	80×110	2208	£245	—	—	Mag.	Zenith	Leather cone	4	B & W	Wood, F.	Fixed	9 8	4 7	13 1	—	7 5	—	810×90
16-24 Grégoire (4) ,,	4	80×160	3212	£315	—	—	Mag.	Zenith	Leather cone	4	Bevel	Wire, D.	Fixed	10 5	4 7	14 6	—	8 1	—	875×105
* 8 G.W.K. (2) England	3	86×92	1064	£126	£150	2	Mag.	Solex	—	4	Bevel	Wire, F.	Fixed	7 7	3 9	10 6	9	—	—	650×65
*12-16 Hampton (4) England	4	75×130	2298	£250	£280	2	Mag.	Zenith	Leather cone	3	Bevel	Sankey, D.	Fixed	9 0	4 3	13 0	9	7 11	6 6½	760×90
*12-16 Hampton (4) ,,	4	75×130	2298	£250	£295	4	Mag.	Zenith	Leather cone	3	Bevel	Sankey, D.	Fixed	9 0	4 3	13 0	9	7 11	6 6½	760×90
12-14 Hansa (4) Germany	4	70×104	1601	—	£260	2 to 4	Mag.	G. & A.	Hele-Shaw	4	Bevel	Wood, F.	Own, D.	—	—	—	—	—	—	—
15.9 Hansa (4) ,,	4	80×104	2088	£345	£385	2	Mag.	G. & A.	Hele-Shaw	4	Bevel	Wood, F.	Own, D.	9 6	4 3	13 2	12	7 10	—	815×105
15.9 Hansa (4) ,,	4	80×104	2088	£345	£405	4	Mag.	G. & A.	Hele-Shaw	4	Bevel	Wood, F.	Own, D	9 6	4 3	13 2	12	7 10	—	815×105
15.9 Hansa (4) (long) ,,	4	80×104	2088	£375	£440	6	Mag.	G. & A.	Hele-Shaw	4	Bevel	Wood, F.	Own, D.	10 6	4 3	13 10	12	8 6	—	815×105
20 Hansa (4) ,,	6	88×104	2530	£385	£490	4	Mag.	G. & A.	Hele-Shaw	4	Bevel	Wood, F.	Own, D.	10 6	4 3	14 7	12	8 6½	—	815×105
25 Hansa (4) ,,	6	88×130	3163	£490	£565	4	Mag.	G. & A.	Hele-Shaw	4	Bevel	Wood, F.	Own, D.	10 8	4 7	14 8	14	8 8½	—	820×120
30 Hansa (4) ,,	6	96×130	3764	£565	£665	4	Mag.	G. & A.	Hele-Shaw	4	Bevel	Wood, F.	Own, D.	10 8	4 7	14 8	14	8 10½	—	880×120
* 9 Hillman (4) England	3	60×120	1360	—	£200	2	Mag.	Solex	Leather cone	3	Worm	Steel, D.	Fixed	7 9	4 0	10 10	8	—	—	700×85
*13-25 Hillman (6) ,,	4	60×120	2040	£375	£480	4	Mag.	Solex	Leather cone	3	Bevel	Steel, D.	Fixed	9 8	4 5	13 0	9	—	7 2	810×100
12-15 Hispano-Suiza (4) France	4	80×110	2208	£340	—	—	Mag.	Own	Multiple disc	3	Bevel	Wood, F.	Fixed	9 0	4 3	—	8	7 8	5 3	810×90
15-25 Hispano-Suiza (4) ,,	4	80×130	2610	£395	—	—	Mag.	Own	Multiple disc	3	Bevel	Wood, F.	Fixed	9 0	4 3	—	8	7 8	5 3	815×105
15.9 Hispano-Suiza (4) ,,	4	80×180	3616	£445	£575	4	Mag.	Own	Leather cone	4	Bevel	R.W., D.	Fixed	8 8	4 0	—	8	6 8	4 7	815×105
*15-35 Hispano-Suiza (4) ,,	4	80×130	2610	£500	—	—	Mag.	Own	Leather cone	4	Bevel	R.W., D.	Fixed	8 8	4 0	—	8	6 8	4 7	815×105
*25-50 Hispano-Suiza (4) ,,	6	90×150	3817	£520	—	—	Mag.	Own	Leather cone	4	Bevel	R.W., D.	Fixed	8 8	4 0	—	8	6 8	4 7	815×105
*30-90 Hispano-Suiza (4) ,,	6	100×180	5655	£680	—	—	Mag.	Own	Leather cone	4	Bevel	R.W., D.	Fixed	8 8	4 0	—	8	6 8	4 7	815×105

*Gladiator complete car prices include hood, screen, dickey with two-seaters, five lamps, horn, and spare wheel or rim. *20 h.p. Grégoire can be fitted with a Claudel carburetter. *G.W.K. is friction driven; complete car price includes hood, screen, lamps, and horn. *Hampton prices include hood, screen, five lamps, and spare wheel without tyre. *9 h.p. Hillman price includes hood, screen, five lamps, horn, spare wheel and tyre; 13-25 h.p. chassis price includes a spare wheel and tyre, and complete price includes hood, screen, lamps, horn, and spare wheel and tyre. *New 1914 model Hispano-Suiza cars fitted with overhead valves and mechanical tyre pump; these models are made in three different wheelbases, the shortest in each case being given.

The Autocars of 1914.—

H.P., Name of Car, Number of Cylinders, and Country of Origin.	Tax in Gns.	Bore and Stroke.	Cubic Capacity.	Price. Chassis with tyres.	Price. Car Complete.	No. of Seats.	Ignition	Carburetter.	Clutch.	No. of Gears	Final Drive.	Wheels.	Rims.	Wheel-base.	Track.	Extreme Length	Road Clearance.	Length of Body Space.	Dash to Back Wheel Centre	Tyres.
		mm.	c.c.											ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	mm.
14-18 Horch (4) (short) Germany	4	75 × 90	1590	£245	—	4 to 6	Mag.	Zenith	Leather cone	4	—	Wood, F.	Fixed	9 2¼	4 1	—	—	—	6 4¾	760 × 90
14-18 Horch (4) (long) ,,	4	75 × 90	1590	£255	—	4 to 6	Mag.	Zenith	Leather cone	4	—	Wood, F.	Fixed	9 8¼	4 1	—	—	—	6 10¾	760 × 90
20-24 Horch (4) (short) ,,	4	75 × 120	2116	£295	—	4 to 6	Mag.	Zenith	Leather cone	4	—	Wood, F.	Fixed	9 2¼	4 1	—	—	—	6 4¾	760 × 90
20-24 Horch (4) (long) ,,	4	75 × 120	2116	£305	—	4 to 6	Mag.	Zenith	Leather cone	4	—	Wood, F.	Fixed	9 8¼	4 1	—	—	—	6 10¾	760 × 90
*25-30 Horch (4) (short) ,,	4	80 × 130	2610	£395	—	4 to 6	Mag.	Zenith	Leather cone	4	—	Wood, F.	Fixed	10 5	4 3¼	—	—	—	7 4½	810 × 100
*25-30 Horch (4) (long) ,,	4	80 × 130	2610	£410	—	4 to 6	Mag.	Zenith	Leather cone	4	—	Wood, F.	Fixed	11 0	4 3¼	—	—	—	7 10½	820 × 120
*25-30 Horch (4) (light) ,,	4	80 × 130	2610	£355	—	4 to 6	Mag.	Zenith	Leather cone	4	—	Wood, F.	Fixed	—	4 3¼	—	—	—	—	—
*35-40 Horch (4) (short) ,,	6	90 × 140	3561	—	—	4 to 6	Mag.	Zenith	Leather cone	4	—	Wood, F.	Fixed	11 0	4 7	—	—	—	7 4½	820 × 120
*35-40 Horch (4) (long) ,,	6	90 × 140	3561	£500	—	4 to 6	Mag.	Zenith	Leather cone	4	—	Wood, F.	Fixed	11 5	4 7	—	—	—	7 10½	820 × 120
*40-50 Horch (4) (short) ,,	6	100 × 150	4704		—	4 to 6	Mag.	Zenith	Leather cone	4	—	Wood, F.	Fixed	11 0	4 7	—	—	—	7 4½	880 × 120
*40-50 Horch (4) (long) ,,	6	100 × 150	4704	£615	—	4 to 6	Mag.	Zenith	Leather cone	4	—	Wood, F.	Fixed	11 5	4 7	—	—	—	7 10½	880 × 120
*50-60 Horch (4) (short) ,,	8	115 × 155	6440	—	—	4 to 6	M. Acc.	Zenith	Leather cone	4	—	Wood, F.	Fixed	11 1	4 7	—	—	—	7 4½	880 × 125
*50-60 Horch (4) (long) ,,	8	115 × 155	6440	£710	—	4 to 6	Mag.	Zenith	Leather cone	4	—	Wood, F.	Fixed	11 7	4 7	—	—	—	7 10½	880 × 125
12-16 Hotchkiss (4) ... France	4	80 × 130	2610	£360	£440	5	Mag.	Zenith	Leather cone	4	Bevel	Wood, F.	Fixed	9 10	4 7	13 8	8¾	8 2½	7 1½	815 × 105
18-22 Hotchkiss (4) ... ,,	6	95 × 140	3964	£480	£570	5 to 7	Mag.	Zenith	Leather cone	4	Bevel	Wood, F.	Fixed	10 10	4 7	14 9½	10	8 8½	7 11	880 × 120
20-30 Hotchkiss (4) ... ,,	8	110 × 150	5702	£600	£700	5 to 7	Mag.	Zenith	Leather cone	4	Bevel	Wood, F.	Fixed	11 4½	4 7½	15 6	10	9 0	8 3	895 × 135
25-35 Hotchkiss (6) ... ,,	10	95 × 130	5520	£650	£750	5 to 7	Mag.	Zenith	Leather cone	4	Bevel	Wood, F.	Fixed	11 1½	4 7	16 2	9½	8 10	7 9	895 × 135
* Hudson (6) .... U.S.A.	8	87 × 127	4529	£425	£475	7	Delco	Zenith	Multiple disc	3	Bevel	Wood, F.	Detach.	—	—	—	—	—	8 0	820 × 120
* 8 Humberette (2) .... England	3	84 × 90	998	—	£135	2	Mag.	Smith	Leather cone	3	Bevel	Wire, F.	Fixed	7 5	3 6	10 3	8	—	—	650 × 65
*10 Humber (4) .... ,,	3	65 × 120	1593	—	£270	4	Mag.	Smith	Leather cone	4	Bevel	Steel, D.	Fixed	8 10½	4 8	12 1	7	—	—	760 × 90
*11 Humber (4) .... ,,	3	69 × 130	1944	—	£310	4	Mag.	Smith	Leather cone	4	Bevel	Wire, D.	Fixed	8 11	4 7	13 4	9½	—	—	810 × 90
*14 Humber (4) .... ,,	4	75 × 140	2474	—	£395	4	Mag.	Smith	Leather cone	4	Bevel	Wire, D.	Fixed	9 6	4 9	13 7	9½	—	—	815 × 105
*20 Humber (4) .... ,,	6	90 × 130	3307	—	£445	5	M. Acc.	Smith	Leather cone	4	Worm	Wire, D.	Fixed	9 6	4 9	14 0	9½	—	—	820 × 120
*28 Humber (4) .... ,,	8	105 × 140	4844	—	£510	5	M. Acc.	Smith	Leather cone	4	Bevel	Wire, D.	Fixed	9 10	4 10	13 11	8½	—	—	820 × 120
*15-18 Hupmobile (4) .. U.S.A.	6	83 × 140	3032	£215	£240	2	Mag.	Zenith	Multiple disc	3	Bevel	Wood, F.	Detach.	8 10	4 7	13 6	9½	7 8	6 10	810 × 90
*15-18 Hupmobile (4) .. ,,	6	83 × 140	3032	£215	£245	4	Mag.	Zenith	Multiple disc	3	Bevel	Wood, F.	Detach.	8 10	4 7	13 6	9½	7 8	6 10	810 × 90
*15-18 Hupmobile (4) .. ,,	6	83 × 140	3032	£215	£285	6	Mag.	Zenith	Multiple disc	3	Bevel	Wood, F.	Detach	10 6	4 7	15 4	9½	9 2	8 6	815 × 105
*10 Hurtu (4) .... France	4	70 × 110	1689	£215	£225	2 to 5	Mag.	Solex	Leather cone	4	Bevel	Wi. or wd., F.	Fixed	8 4	4 2	12 4	8	7 1	6 2	700 × 90
*14 Hurtu (4) .... ,,	4	75 × 120	2116	£245	£255	2 to 5	Mag.	Solex	Leather cone	4	Bevel	Wi. or wd., F.	Fixed	9 0	4 2	13 0	8	7 9	6 9	760 × 90
8-10 Imperia (4) (short) Belgium	4	75 × 100	1767	£290	£350	4	Mag.	Zenith	Multiple disc	3	Bevel	Wood, F.	Fixed	9 1	4 1¼	12 3⅝	8	7 6½	5 5	760 × 90
8-10 Imperia (4) (long) ,,	4	75 × 100	1767	£290	£350	4	Mag.	Zenith	Multiple disc	3	Bevel	Wood, F.	Fixed	9 9	4 1¼	12 11½	8	8 2½	6 1	760 × 90
10-12 Imperia (4) ..... ,,	3	69 × 120	1795	£300	£360	4	Mag.	Zenith	Leather cone	4	Bevel	Wire, D.	Fixed	8 6¾	4 3¼	12 6¾	8	7 8½	5 9½	760 × 90
14-16 Imperia (4) (short) ,,	4	80 × 130	2610	£350	£420	5	Mag.	Zenith	Leather cone	4	Bevel	Wire, D.	Fixed	10 5	4 5	14 2⅞	9	8 4½	6 4	815 × 105
14-16 Imperia (4) (long) ,,	4	80 × 130	2610	£350	£420	5	Mag.	Zenith	Leather cone	4	Bevel	Wire, D.	Fixed	11 0⅞	4 5	14 10¾	9	9 0¼	7 0	815 × 105
18-24 Imperia (4) (short) ,,	6	90 × 140	3561	£390	£460	5	Mag.	Zenith	Leather cone	4	Bevel	Wire, D.	Fixed	10 6¾	4 5	14 4¼	9	8 4½	6 4	815 × 105
18-24 Imperia (4) (long) ,,	6	90 × 140	3561	£390	£460	5	Mag.	Zenith	Leather cone	4	Bevel	Wire, D.	Fixed	11 2⅝	4 5	15 0¼	9	9 0¼	7 0	820 × 120
28-35 Imperia (4) (short) ,,	6	100 × 160	5027	£475	£550	5	Mag.	Zenith	Leather cone	4	Bevel	Wire, D.	Fixed	10 9⅜	4 5	14 6	9	8 4½	6 4	880 × 120
28-35 Imperia (4) (long) ,,	6	100 × 160	5027	£475	£550	5	Mag.	Zenith	Leather cone	4	Bevel	Wire, D.	Fixed	11 5¼	4 5	15 3	9	9 0¼	7 0	880 × 120
15 Iris (4) .... England	4	80 × 114	2292	£350	£450	4	Mag.	Own	Leather cone	3	Bevel	Wood, F.	Fixed	9 4	4 6	12 8	8	7 11	7 1	815 × 105
15 Iris (4) (Colonial) .. ,,	4	80 × 114	2292	£375	£475	5	Mag.	Own	Leather cone	3	Bevel	Wood, F.	Fixed	9 4	4 6	12 8	12½	7 11	7 1	875 × 105
25 Iris (4) .... ,,	8	108 × 133	4874	£575	£690	5	Mag.	Own	Multiple disc	3	Bevel	Wood, F.	Fixed	10 6	4 8	14 2	8	8 10	7 5	880 × 120
35 Iris (4) .... ,,	10	127 × 133	6739	£700	£825	5	M. Acc.	Own	Leather cone	3	Bevel	Wood, F.	Fixed	11 0	4 8	14 8	8	9 3⅝	7 11⅝	880 × 120
14-18 Isotta-Fraschini (4) Italy	4	75 × 130	2298	£360	-	-	Mag.	Zenith	Multiple disc	4	Bevel	—	—	9 0	4 8	—	—	—	—	810 × 90
18-25 Isotta-Fras. (4) (short) ,,	6	85 × 130	2938	£440	-	-	Mag.	Zenith	Multiple disc	4	Bevel	—	—	9 6	4 4½	—	—	—	—	815 × 105
18-25 Isotta-Fras. (4) (long) ,,	6	85 × 130	2938	£440	-	-	Mag.	Zenith	Multiple disc	4	Bevel	—	—	10 0	4 4½	—	—	—	—	820 × 120

*Front tyres on the 25-30 h.p. Horch are 810 × 90, on the 35-40 h.p. 815 × 105, on the 40-50 h.p. and the 50-60 h.p. 875 × 105. *Hudson prices (car and chassis) include Delco electrical system of engine starting and lighting, clock, speedometer, electric horn, and all lamps; and in the case of the complete car, one-man hood, luggage grid, and tyre carrier. *Humberette and Humber prices include hood, screen, five lamps, spare wheel and tyre (except the Humberette), and horn; price of the 14 h.p. includes electric lighting set, and engine starter; price of Humberette air-cooled model, £120. *Prices of Hupmobile cars fitted with engine starters are £280, £285, and £315; complete car prices include lamps, hood, and screen. *Hurtu prices include three lamps, and horn.

The Autocars of 1914.—

H.P., Name of Car, Number of Cylinders, and Country of Origin.	Tax in Gns.	Bore and Stroke.	Cubic Capacity.	Price. Chassis with tyres.	Price. Car Complete.	No. of Seats.	Ignition	Carburetter.	Clutch	No. of Gears	Final Drive.	Wheels.	Rims.	Wheelbase.	Track.	Extreme Length	Road Clearance.	Length of Body Space.	Dash to Back Wheel Centre	Tyres.
		mm.	c.c.											ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	mm.
25-35 Isotta-Fras. (4) (short) Italy	6	100 × 140	4396	£560	—	—	Mag.	Zenith ..	Multiple disc	4	Bevel	—	—	10 4½	4 7	—	—	—	—	820 × 120
25-35 Isotta Fras. (4) (long) ,,	6	100 × 140	4396	£580	—	—	Mag.	Zenith ..	Multiple disc	4	Bevel	—	—	10 8	4 7	—	—	—	—	820 × 120
35-45 Isotta-Fraschini (4) ,,	8	110 × 160	6082	£690	—	—	Mag.	Zenith ..	Multiple disc	4	Bevel	—	—	10 5½	4 7	—	—	—	—	—
45-55 Isotta-Fraschini (4) ,,	—	—	—	£800	—	—	Mag.	Zenith ..	Multiple disc	4	Bevel	—	—	—	—	—	—	—	—	880 × 120
70-80 Isotta-Fras. (4) (short) ,,	8	105 × 180	6235	£1040	—	—	Mag.	Zenith ..	Multiple disc	4	Bevel	—	—	10 4½	4 7	—	—	—	—	880 × 120
70-80 Isotta-Fras. (4) (long) ,,	8	105 × 180	6235	£1040	—	—	Mag.	Zenith ..	Multiple disc	4	Chain	—	—	10 10¼	4 8	—	—	—	—	920 × 120
100 Isotta-Fraschini (4) ,,	21	130 × 200	10618	£1185	—	—	Mag.	Own	Multiple disc	4	Chain	Wood, F. ...	Fixed ..	10 10¼	4 7⅞	14 8	—	8 2½	5 6⅝	935 × 135
*14-20 Itala (4) .... ,,	4	77 × 120	2235	£350	£455	4	Mag.	Own	Multiple disc	4	Bevel	Wood, F. ...	Warland	9 2	4 5	12 11	8	7 8	6 10	815 × 105
18-30 Itala (4) .... ,,	6	90 × 130	3307	£480	—	—	Mag.	Own	Multiple disc	4	Bevel	Wood, F. ...	Fixed ..	10 5	4 5½	14 2½	8½	8 8	7 8	815 × 105
25-35 Itala (4) .... ,,	8	115 × 130	5401	£595	—	—	Mag.	Own	Multiple disc	4	Bevel	Wood, F. ..	Fixed ..	10 6	4 7½	14 4½	8½	8 10	7 9	880 × 120
35-45 Itala (4) .... ,,	10	127 × 140	7090	£715	—	—	Mag.	Own	Multiple disc	4	Bevel	Wood, F. ...	Fixed ..	10 10½	4 8	15 0	8½	8 10	7 9	895 × 135
50-65 Itala (4) .... ,,	21	140 × 150	9236	£815	—	—	Mag.	Own	Multiple disc	4	Bevel	Wood, F. ...	Fixed ..	11 1¼	4 8	15 3	8½	8 10	7 9	895 × 135
60-70 Itala (4) (Grand Prix) ,,	10	127 × 160	8107	£865	—	—	Mag.	Own	Multiple disc	4	Bevel	Wood, F. ..	Fixed ..	11 2¼	4 8	15 4	8½	8 10	7 9	895 × 135
100 Itala (4) (Grand Prix) ,,	21	155 × 160	12070	£1215	—	—	Mag.	Own	Multiple disc	4	Bevel	Wood, F. ...	Fixed ..	11 6¾	4 8	15 3	8½	8 10	7 8	895 × 135
25 Itala (4) (rotary valve) ,,	6	90 × 140	3561	£615	—	—	Dual	Own	Multiple disc	4	Bevel	Wood, F. ...	Fixed ..	10 6½	4 7½	14 4½	8½	8 8	7 9	820 × 120
35 Itala (4) (rotary valve) ,,	8	105 × 150	5195	£765	—	—	Dual	Own	Multiple disc	4	Bevel	Wood, F. ...	Fixed ..	10 10	4 7½	15 0	8½	8 10	7 9	880 × 120
50 Itala (4) (rotary valve) ,,	21	130 × 160	8495	£1650	—	—	Dual	Own	Multiple disc	4	Bevel	R.-W., D. ...	Fixed ..	11 0	4 7½	15 3	8½	8 10	7 9	895 × 135
60 Itala (6) .... ,,	21	127 × 140	10634	£975	—	—	Dual	Own	Multiple disc	4	Bevel	Wood, F. ...	Fixed ..	11 9¾	4 8	15 11¼	8½	8 10	7 9	895 × 135
75 Itala (6) .... ,,	42	140 × 140	12912	£1015	—	—	Dual	Own	Multiple disc	4	Bevel	Wood, F. ...	Fixed ..	11 9¾	4 8	15 11¼	8½	8 10	7 9	895 × 135
*12-15 Jackson (4) ..... France ..	3	65 × 130	1728	£210	£275	3	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	8 9	4 1	12 0	8½	7 0	7 0	710 × 90
*12-15 Jackson (4) ..... ,,	3	65 × 130	1728	£210	£290	4	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	8 9	4 1	12 0	8½	7 0	7 0	710 × 90
J.B.S. (2) .... England	3	85 × 85	964	—	£120	2	Mag.	Lukin ..	Leather cone	4	Bevel	Wire, F.	Fixed ..	7 6	4 0	10 3½	8	6 3	5 3½	650 × 65
*38 Jeffery (4) .... U.S.A.	6	95 × 133	3772	—	—	2	M. Acc.	—	Leather cone	4	Bevel	Wood, F. ...	Detach.	9 8	4 8	—	—	—	—	875 × 105
*38 Jeffery (4) .... ,,	6	95 × 133	3772	—	—	5	M. Acc.	—	Leather cone	4	Bevel	Wood, F. ...	Detach.	9 8	4 8	—	—	—	—	875 × 105
*48 Jeffery (6) .... ,,	10	95 × 133	5658	—	—	5	M. Acc.	Rayfield	Leather cone	4	Bevel	Wood, F. ...	Detach.	10 8	4 8	—	—	—	—	920 × 120
* Kestrel (4) .... England	3	60 × 100	1128	—	—	2	Mag.	Zenith ..	—	4	—	Wood, D. ...	Fixed ..	7 6	3 9	9 9	8	6 0	4 6	700 × 80
*23 King (4) .... U.S.A.	6	98 × 125	3775	£260	£295	5	Dual	Stromberg	Disc	3	Bevel	Wood, F. ...	Captain .	9 2	4 9	12 6	8½	7 6	6 6	820 × 120
*11 Knight Junior (4) .. England	3	68 × 120	1743	—	£185	3	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	8 6	4 3	12 0	7	—	—	700 × 85
*15 Knight of Road (4) . ,,	4	80 × 130	2610	—	£368	5	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	9 6	4 8	13 2	9	—	—	810 × 100
*10 La Buire (4) .... France ..	3	65 × 130	1728	£260	—	—	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	8 6	3 11½	—	8½	7 6½	—	760 × 90
*12 La Buire (4) .... ,,	4	70 × 150	2304	£300	—	—	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	8 11	4 4¼	—	8½	8 1¼	—	810 × 90
*15 La Buire (4) .... ,,	4	80 × 160	3212	£360	—	—	Mag.	Zenith ..	Disc	4	Bevel	Wood, F. ...	Fixed ..	10 0	4 4¼	—	9	8 2½	—	815 × 105
*20 La Buire (4) .... ,,	6	90 × 160	4070	£440	—	—	Mag.	Zenith ..	Disc	4	Bevel	Wood, F. ...	Fixed ..	10 2	4 7	—	9	8 7	—	820 × 120
*24 La Buire (6) .... ,,	8	85 × 140	4764	£520	—	—	Mag.	Zenith ..	Disc	4	Bevel	Wood, F. ...	Fixed ..	10 8¾	4 7	—	9½	8 10	—	880 × 120
*30 La Buire (6) .... ,,	8	90 × 140	5342	£560	—	—	Mag.	Zenith ..	Disc	4	Bevel	Wood, F. ...	Fixed ..	10 8¾	4 7	—	9½	8 10	—	880 × 120
*11 Lagonda (4) (coupé) England	3	67 × 78	1100	—	£150	2	Mag.	S.U.	Leather cone	3	Worm	Steel, D.	Fixed ..	7 9	3 10	10 6	8	—	—	650 × 75
*10 Lambert-Herbert (4) England	3	60 × 110	1245		£225	2	Mag.	Zenith ..	Leather cone	3	Bevel	Steel, D.	Fixed ..	8 0	3 7	10 8	9	—	—	700 × 80
25 Lanchester (4) ..... England	6	101 × 101	3237	£575	£725	5	Dual	Own	Multiple disc	3	Worm	R.-W., D. ...	Fixed ..	10 5	4 8½	14 0	10	6 5	6 9	880 × 120
25 Lanchester (4) ..... ,,	6	101 × 101	3237	£575	£800	7	Dual	Own	Multiple disc	3	Worm	R.-W., D. ...	Fixed ..	10 5	4 8½	14 0	10	6 5	6 9	880 × 120
25 Lanchester (4) (Col.) ,,	6	101 × 101	3237	£575	£735	7	Dual	Own	Multiple disc	3	Worm	R.-W., D. ...	Fixed ..	10 7	4 8½	14 2	12	6 5	6 9	1020 × 120
*38 Lanchester (6) ..... ,,	10	101 × 101	4856	£885	£1035	5	Dual	Own	Multiple disc	3	Worm	R.-W., D. ...	Fixed ..	11 8	4 8½	14 9	10	7 8	8 0	895 × 135
*38 Lanchester (6) ..... ,,	10	101 × 101	4856	£885	£1110	7	Dual	Own	Multiple disc	3	Worm	R.-W., D. ...	Fixed ..	11 8	4 8½	14 9	10	7 8	8 0	895 × 135
*38 Lanchester (6) (Col.) ,,	10	101 × 101	4856	£885	£1050	7	Dual	Own	Multiple disc	3	Worm	R.-W., D. ...	Fixed ..	11 10	4 8½	15 0	12	7 8	8 0	1020 × 120

*Chassis price of 14-20 h.p. Itala includes electric dynamo, engine starter, and lamps; complete price includes hood and screen. *Jackson automatic engine starter, £10 extra. *Jeffery cars are all fitted with engine starting and electric lighting systems. *Kestrel is friction driven. * King complete car price includes five electric lamps, spare rim, one man hood and screen. * Knight Junior price includes five lamps; Knight of Road price includes dynamo lighting installation, speedometer, spare wheel and tyre. *All La Buire cars have double bevel drive; prices of the last four models do not include tyres. *Lagonda price includes five lamps, horn, and spare wheel. *Lambert-Herbert price includes hood, screen, electric dynamo with five lamps, spare wheel and tyre, clock, speedometer, and horn. *Prices of the 38 h.p. Lanchester include the Lanchester electric engine starter, and electric lighting system with five lamps.

The Autocars of 1914.—

H.P., Name of Car, Number of Cylinders, and Country of Origin.	Tax in Gns.	Bore and Stroke.	Cubic Capacity.	Price. Chassis with tyres.	Price. Car Complete.	No. of Seats.	Ignition	Carburetter.	Clutch.	No. of Gears	Final Drive.	Wheels.	Rims.	Wheelbase.	Track.	Extreme Length	Road Clearance.	Length of Body Space.	Dash to Back Wheel Centre	Tyres.
		mm.	c.c.											ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	mm.
*15 Lancia (4) ....Italy ...	4	80×130	2610	£380	—	—	Mag.	Own	Disc	4	Bevel	Wood, F. ...	Michelin	9 4	4 4½	12 0	8¼	8 0	6 10	815×105
*20-30 Lancia (4) (short) ,,	6	100×130	4082	£495	—	—	Mag.	Own	Disc	4	Bevel	Wire, F.	Vinet ..	9 8	4 4½	13 0	8¼	8 1	6 11	820×120
*20-30 Lancia (4) (long) ,,	6	100×130	4082	£495	—	—	Mag.	Own	Disc	4	Bevel	Wire, F.	Vinet ..	10 6	4 4½	14 6	8¼	9 0	7 10½	820×120
*35 Lancia (4) (short) ..Italy	8	110×130	4942	£575	—	—	Mag.	Own	Disc	4	Bevel	Wire, F.	Vinet ..	10 0	4 4½	14 2	8¼	8 7½	7 3½	835×135
*35 Lancia (4) (long) ... ,,	8	110×130	4942	£575	—	—	Mag.	Own	Disc	4	Bevel	Wire, F.	Vinet ..	10 10	4 4½	15 0	8¼	9 6	8 1½	835×135
*10 La Ponette (4) .....France..	3	65×110	1460	£190	£240	3	Mag.	Claudel..	Leather cone	3	Bevel	Wire, F.	Fixed ..	8 2	4 0	11 4½	8½	6 4½	5 7½	710×90
* 7-20 Laurin-Klement (4) Austria	4	70×120	1843	£285	£370	4	Mag.	Zenith ..	Multiple disc	4	Bevel	Wood, F. ...	Fixed ..	9 2	3 11	14 0	10	7 7	6 11	760×90
12-16 Lawton (4) .....England	4	80×120	2409	£295	£350	4	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 0	4 5	12 8	—	8 1	7 0	815×105
20-30 Lawton (4) ..... ,,	6	100×140	4396	£495	£650	5	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 0	4 7	14 2	—	8 4	7 2	880×120
10 Le Gui (4) ....France..	3	65×110	1460	£215	£250	2	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	8 2	4 1	11 0	7½	—	—	700×85
12 Le Gui (4) .... ,,	4	75×120	2116	£255	£335	4 or 5	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	8 10	4 1	12 0	8½	—	—	760×90
15 Le Gui (4) .... ,,	4	80×150	3012	£315	£380	4 or 5	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 6	4 5	13 0	9½	—	—	815×105
*14 Léon Bollée (4) ....France..	4	75×110	1940	£350	—	—	Mag.	Claudel..	Leather cone	4	Bevel	R.-W., D. ...	Fixed ..	9 7	4 6	—	—	—	—	765×105
*16 Léon Bollée (4) .... ,,	6	83×110	2381	£385	—	—	Mag.	Claudel..	Leather cone	4	Bevel	R.-W., D. ...	Fixed ..	9 7	4 6	—	—	—	—	815×105
*18 Léon Bollée (4) .... ,,	6	85×120	2714	£405	—	—	Mag.	Claudel..	Leather cone	4	Bevel	R.-W., D. ...	Fixed ..	9 11	4 6	—	—	—	—	820×120
*26 Léon Bollée (6) .... ,,	6	83×110	3571	£550	—	—	Mag.	Claudel..	Leather cone	4	Bevel	R.-W., D. ...	Fixed ..	10 6	4 6	—	—	—	—	835×135
14 Licorne (4) ....France..	3	65×130	1728	£275	—	—	Mag.	Claudel..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 3	4 3	—	8	—	—	810×90
14 Licorne (4) .... ,,	4	75×120	2116	£210	£243	2	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	9 3	4 3	—	8	—	—	800×85
14 Licorne (4) .... ,,	4	75×120	2116	£240	£300	2	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 3	4 3	—	8	—	—	810×90
14 Licorne (4) .... ,,	4	75×150	2651	£310	—	—	Mag.	Claudel..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 0	4 4	—	9	—	—	815×105
8 L.M. (2) (de luxe) ..England	3	85×85	964	—	£142	2	Mag.	B. & B. .	Mult. plate .	3	Chain	Wire, F.	Fixed ..	7 9	3 3	10 3	—	—	—	650×65
*12-16 Lorraine-Dietrich (4) F'nce	4	75×120	2116	£310	—	—	Mag.	Own	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 4	4 5	12 10	7½	8 1	7 1	815×105
*12-16 Lor.-Dietrich (4) (light) ,,	4	75×120	2116	£300	—	—	Mag.	Own	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 4	4 5	12 10	7½	8 1	7 1	815×105
*14-18 Lorraine-Dietrich (4) ,,	4	80×130	2610	£345	—	—	Mag.	Own	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 9	4 5	13 9	7	8 2½	7 3¾	815×105
*18-20 Lorraine-Dietrich (4) ,,	6	90×130	3307	£415	—	—	Mag.	Own	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 5	4 7	14 5½	7½	8 6	7 7½	880×120
*18-20 Lor.-Dietrich (4) (light) ,,	6	90×130	3307	£405	—	—	Mag.	Own	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 5	4 7	14 5½	7½	8 6	7 7½	880×120
*20-30 Lorraine-Dietrich (4) ,,	6	95×160	4536	£505	—	—	Mag.	Own	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 5	4 7	14 7	7	8 10	7 5½	880×120
*20-30 L.-Dietrich (4) (sport'g) ,,	6	95×160	4536	£545	—	—	Mag.	Own	Leather cone	4	Bevel	R.-W., D. ...	Fixed ..	10 0	4 7	14 1	5¾	8 3½	6 10	820×120
*40-75 Lorraine-Dietrich (4) ,,	10	125×170	8345	£760	—	—	Mag.	Own	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 11	4 8¾	15 2	7	9 0	7 5½	935×135
*40-75 L.-Dietrich (4) (sport'g) ,,	10	125×170	8345	£760	—	—	Mag.	Own	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 3	4 8¾	14 6	7	8 4	6 9½	920×120
* Lozier (4) ........U.S.A.	8	108×165	6046	£410	£480	2 to 7	Dual	Rayfield	Multiple disc	3	Bevel	Wood, F. ...	Stanweld	10 0	4 8	15 0	11	—	—	910×115
*36 Lozier (6) .... ,,	10	98×140	6336	£650	£720	2 to 7	Dual	Rayfield	Multiple disc	3	Bevel	Wood, F. ...	Stanweld	10 7½	4 8	15 0	11	9 0	7 1	910×115
*51 Lozier (6) .... ,,	21	117×140	9030	£950	£1060	2 to 7	M. Acc.	Rayfield	Multiple disc	4	Bevel	Wood, F. ...	Stanweld	10 11	4 8	15 3½	11	9 0	7 1	940×120
25 Marathon (4) ......U.S.A.	6	87×114	2708	—	£235	5	Dual	Schebler	Multiple disc	3	Bevel	Wood, F. ...	Baker ..	8 8	4 8	13 10	10	—	6 0	800×90
35 Marathon (4) ..... ,,	8	108×114	4177	—	£310	5	Dual	Schebler	Multiple disc	3	Bevel	Wood, F. ...	Baker ..	9 8	4 8	15 0	10	—	—	870×100
45 Marathon (4) ..... ,,	8	114×130	5308	—	£395	5	Dual	Schebler	Multiple disc	3	Bevel	Wood, F. ...	Baker ..	10 3	4 8	15 6	10	—	—	910×100
* 8-10 Marlborough (4) .France..	3	59×100	1094	£165	£190	2	Mag.	Claudel..	Multiple disc	3	Bevel	Sankey, D. ..	Fixed ..	9 0	4 2	12 0	9	7 1	6 8	700×85
* 8-10 Marshall-Arter (2) England	3	85×85	964	£120	£142	2	Mag.	Solex ...	Leather cone	2	Bevel	Wire, F.	Fixed ..	8 6	3 7	11 4	7½	7 8	6 8	650×65
*10-12 Marshall-Arter (4) ,,	3	59×100	1094	£134	£158	2	Mag.	Zenith ..	Leather cone	2	Bevel	Wire, F.	Fixed ..	8 9	3 7	11 7	7½	7 7	6 7	650×65
*12-14 Marshall-Arter (4) ,,	3	60×110	1245	£137	£160	2	Mag.	Zenith ..	Leather cone	2	Bevel	Wire, F.	Fixed ..	8 9	3 7	11 7	7½	7 7	6 7	650×65
*12-14 Marshall-Arter (4) ,,	3	60×110	1245	£142	£184	4	Mag.	Zenith ..	Leather cone	2	Bevel	Wire, F.	Fixed ..	9 0	3 7	12 1	7½	7 10	6 10	700×85
*12-14 Marshall-Arter (4) (coupé)	3	60×110	1245	£137	£200	2	Mag.	Zenith ..	Leather cone	2	Bevel	Wire, F.	Fixed ..	8 9	3 7	11 7	7½	7 7	6 7	650×65
20-25 Martini (4) .. Switzerland	4	80×130	2610	£350	—	—	Mag.	Claudel..	Contract. bnd	4	Bevel	Wood, F. ...	Fixed ..	9 5	4 3	13 3	10	8 0	6 11	815×105
20-30 Martini (4) (sporting) ,,	6	85×130	2938	£400	—	—	Mag.	Claudel..	Contract. bnd	4	Bevel	Steel, D.	Fixed ..	9 1	4 3	13 0	10	7 7	6 7	815×105

*15 h.p. Lancia price includes spare rim; 20-30 h.p. price includes complete electric lighting installation, all lamps, electric horn, and speedometer; 35 h.p. Lancia price includes engine starter, complete electric lighting installation, all lamps, electric horn, and speedometer. *La Ponette complete car price includes hood, screen, lamps, and speedometer. *Laurin-Klement complete car price includes hood, screen, five lamps, and horn. *Léon Bollée prices include spare wheel; the 16 h.p. is also supplied with a 9ft. 11in. wheelbase, price being the same as for the shorter chassis. *Lorraine-Dietrich prices do not include tyres. *Four-cylinder Lozier chassis price includes complete electric lighting and starting installation, electric horn, and speedometer; the 36 h.p. has in addition a luggage grid, spare rim, and clock; the 51 h.p. has a clock and spare rims; complete cars have in addition hoods and screens; the 51 h.p. model has a double-spark magneto, and the front tyres are 910×115; the detachable rims on all models have detachable flanges. *Marlborough chassis price includes spare wheel and tyre; complete car price includes hood and screen. *Marshall-Arter complete car prices include hood, screen, three lamps, and horn.

The Autocars of 1914.—

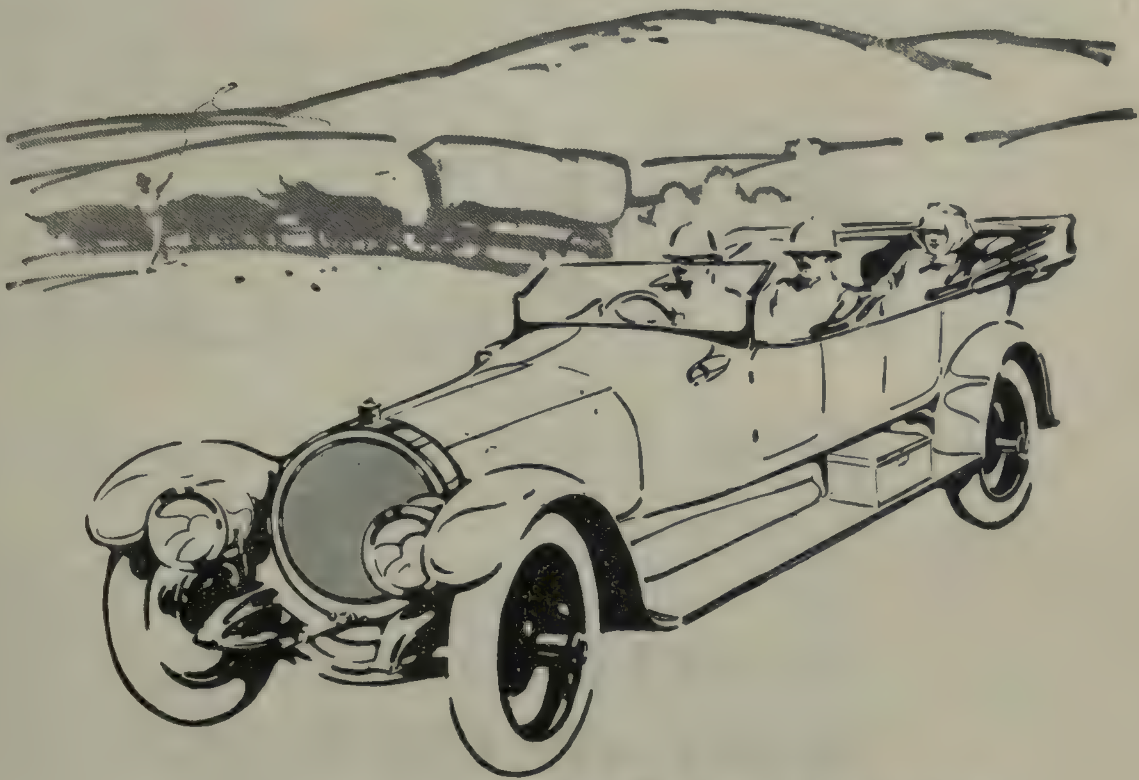
H.P., Name of Car, Number of Cylinders, and Country of Origin.	Tax in Gns.	Bore and Stroke.	Cubic Capacity.	Price. Chassis with tyres.	Price. Car Complete.	No. of Seats.	Ignition	Carburetter.	Clutch.	No. of Gears	Final Drive.	Wheels.	Rims.	Wheel-base.	Track.	Extreme Length	Road Clearance.	Length of Body Space.	Dash to Back Wheel Centre	Tyres.
		mm.	c.c.											ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	mm.
25-30 Martini (4) ...Switzerland	6	90×140	3561	£450	—	—	Mag.	Claudel..	Contract. bnd	4	Bevel	Steel, D.	Fixed ..	10 3½	4 5	14 4	11	8 6	7 10	820×120
10 Mass (4) ....France..	3	68×120	1743	£200	£250	4	Mag.	Zenith ..	Leather cone	4	Bevel	Mass wood, D.	Fixed ..	8 2	3 11	11 6	9	7 0	5 10	750×85
12 Mass (4) .... "	4	75×130	2298	£250	£320	4	Mag.	Claudel..	Leather cone	4	Bevel	Mass wood, D.	Fixed ..	8 2	3 11	11 6	8½	7 0	5 10	810×80
15.9 Mass (4) (landaulet) "	4	80×140	2811	£300	£450	4	Mag.	Zenith ..	Leather cone	4	Bevel	Mass wood, D.	Fixed ..	9 8	4 3	14 0	9	8 0	6 5	815×105
16-20 Mass (4)........ France	6	90×150	3817	£335	£400	2	Mag.	Claudel..	Leather cone	3	Bevel	Mass wood, D.	Fixed ..	10 6	4 3	14 3	9	8 8	7 3	815×105
20 Mass (4) (cabriolet) . "	6	100×170	5341	£475	£600	6	Mag.	Claudel..	Leather cone	4	Bevel	Mass wood, D.	Fixed ..	10 8	4 3	14 7	8½	9 0	8 6	820×120
*20 Mass-Paige (4) .....U.S.A.	6	95×102	2892	—	£235	4	Dual	—	—	3	Bevel	—	Detach.	8 8	—	—	—	—	—	810×90
*25 Mass-Paige (4) .. . "	6	102×127	4227	—	£295	5	Dual	—	—	3	Bevel	—	Detach.	9 8	4 8	—	—	—	—	—
*17 Maudslay (4) ......England	6	90×130	3307	£425	£550	—	Dual	Own	Leather cone	4	Bevel	Wire, D.	Fixed ..	10 0	4 6	14 0	8	8 0	7 0	820×120
*17 Maudslay (4) (long) "	6	90×130	3307	£430	£555	—	Dual	Own	Leather cone	4	Bevel	Wire, D.	Fixed ..	10 6	4 6	14 6	8	8 6	7 6	820×120
*27 Maudslay (6) ...... "	8	90×130	4961	£595	£725	—	Dual	Own	Leather cone	4	Bevel	Wire, D.	Fixed ..	11 6	4 6	15 3	8	8 6	7 6	880×120
12-15 Mercédès (4) ....Germany	4	70×120	1843	£325	—	—	Mag.	Own	Leather cone	4	Bevel	—	—	9 0⅝	4 3¼	13 5½	—	8 0½	7 1	815×105
15-20 Mercédès (4) .... "	4	80×130	2610	£425	—	—	Mag.	Own	Leather cone	4	Bevel	—	—	10 1	4 5	14 3¼	—	8 6½	7 7	820×120
15-25 Mercédès (4) (Knight) "	4	80×130	2610	£525	—	—	Dual	Own	Leather cone	4	Bevel	—	—	10 7½	4 6	—	—	8 6½	—	820×120
25-30 Mercédès (4) .... "	6	90×140	3561	£550	—	—	Mag.	Own	Leather cone	4	Bevel	—	—	10 1	4 5½	14 3¼	—	8 6½	7 7	820×120
25-30 Mercédès (4) (Knight) "	6	100×130	4082	£675	—	—	Dual	Own	Leather cone	4	Bevel	—	—	10 7½	4 6	—	—	8 6½	—	820×120
*35-40 Mercédès (4) .... "	8	110×150	5702	£675	—	—	Dual	Own	Leather cone	4	Bevel	—	—	11 3	4 7¾	15 7¾	—	9 0½	8 2½	895×135
35-40 Mercédès (4) (Colonial) "	8	110×150	5702	£700	—	—	Dual	Own	Leather cone	4	Chain	—	—	11 4¾	5 3	—	12	8 6½	—	1020×120
*40-45 Mercédès (4) (Knight) "	10	120×140	6333	£975	—	—	Dual	Own	Leather cone	4	Bevel	—	—	11 10½	5 0	—	—	9 0½	—	935×135
*45-50 Mercédès (4) .... "	10	120×160	7238	£750	—	—	Mag.	Own	Leather cone	4	Bevel	—	—	11 3	4 7¾	15 7¾	—	9 0½	8 2½	935×135
*45-50 Mercédès (4) .... "	10	120×160	7238	£775	—	—	Mag.	Own	Leather cone	4	Chain	—	—	11 4¾	4 11⅞	15 6	—	8 6½	8 1½	935×135
*80-90 Mercédès (4) .... "	21	130×180	9568	£1150	—	—	Mag.	Own	Leather cone	4	Chain	—	—	11 9	4 11⅞	16 3¼	—	8 6½	8 1½	935×135
*65-70 Mercédès (4) .... "	21	140×160	9856	£1000	—	—	Mag.	Own	Leather cone	4	Chain	—	—	11 6⅞	4 11⅞	16 0	—	8 6½	8 1½	935×135
12-14 Mercury (4) .....England	4	75×110	1940	—	£210	2	Mag.	S.U.	Saver	3	Bevel	Sankey, D. ..	Fixed ..	9 3	4 6	11 3	10½	7 9	6 3	810×90
*15-20 Métallurgique (4) Belgium	4	80×130	2610	£385	£475	4 to 5	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	9 6¾	4 3¾	13 2¾	—	7 10½	—	815×105
*20-30 Métallurgique (4) "	6	90×140	3561	£525	—	—	Mag.	Zenith ..	Metal exp'g	4	Bevel	Wood, D. ...	Fixed ..	11 0	4 5¼	14 8¾	—	9 0	—	820×120
*20-40 Métallurg. (4) (light) "	6	90×140	3561	£525	£650	4 to 5	Mag.	Zenith ..	Metal exp'g	4	Bevel	Wood, D. ...	Fixed ..	10 4¾	4 3¼	14 1	—	8 2½	—	820×120
*26-50 Métallurgique (4) "	6	102×150	4903	£625	—	—	Mag.	Zenith ..	Metal exp'g	4	Bevel	Wood, D. ...	Fixed ..	11 6¼	4 8	15 3	—	9 4¼	—	820×120
*38-80 Métallurgique (4) "	10	125×150	7363	£875	—	—	Mag.	Zenith ..	Metal exp'g	4	Bevel	Wood, D. ...	Fixed ..	12 0	4 8	16 6	—	9 4¼	—	895×135
*38-90 Métallurg. (4) (light) "	10	125×150	7363	£950	—	—	Mag.	Zenith ..	Metal exp'g	4	Bevel	Wood, D. ...	Fixed ..	10 11	4 8	14 8	—	8 2½	—	895×135
*20-28 Meteor (6) ......England	6	75×110	2910	£470	—	5	Mag.	Stewart	Leather cone	4	Bevel	Sankey, D. ..	Fixed ..	11 2	4 8	15 10	10	8 6	—	880×120
* 9-10 Meteorite (4) .... "	3	60×110	1245	—	£175	2	Mag.	Solex ...	Multiple disc	3	Bevel	Sankey, D. ..	Fixed ..	8 6	4 0	11 0	9	—	—	700×85
15-20 Miesse (4) ......Belgium	4	80×140	2811	£360	—	—	Mag.	Zenith ..	Multiple disc	4	Bevel	Riley, D.	Fixed ..	10 2	4 8½	14 2	7	8 6	—	815×105
15-20 Miesse (4) (Colonial) "	4	80×140	2811	£360	—	—	Mag.	Zenith ..	Multiple disc	4	Worm	Riley, D.	Fixed ..	10 2	4 8½	14 2	12	8 6	—	875×105
20-30 Miesse (4) ...... "	6	100×140	4396	£425	—	—	Mag.	Zenith ..	Multiple disc	4	Bevel	Riley, D.	Fixed ..	10 2	4 8½	14 2	7	8 6	—	880×120
20-30 Miesse (4) (Colonial) "	6	100×140	4396	£425	—	—	Mag.	Zenith ..	Multiple disc	4	Worm	Riley, D.	Fixed ..	10 2	4 8½	14 2	12	8 6	—	880×120
14 Minerva (4) ....Belgium	4	75×120	2116	£340	—	—	Mag.	G. & A. .	Leather cone	4	Worm	Wire, D.	Fixed ..	9 6½	4 3	—	8	8 0	—	815×105
18 Minerva (4) .... "	6	90×130	3307	£450	—	—	Dual	G. & A. .	Leather cone	4	Bevel	Wire, D.	Fixed ..	10 8	4 5	—	6½	8 10	—	820×120
*26 Minerva (4) .... "	6	100×140	4396	£545	—	—	Dual	G. & A. .	Leather cone	4	Bevel	Wire, D.	Fixed ..	10 6	4 8	—	8¼	8 6	—	880×120
*38 Minerva (4) .... "	10	124×150	7232	£625	—	—	Dual	G. & A. .	Leather cone	4	Bevel	Wire, D.	Fixed ..	10 9	4 8	—	7½	8 6	—	880×120
Mitchell (4) .......U.S.A.	8	108×178	6495	£350	£380	5	Dual	Rayfield	Leather cone	3	Bevel	Wood, F. ...	Detach. .	10 0	4 8	13 9	9	—	—	920×120
Mitchell (6) .... "	21	108×153	8327	£420	£450	7	Dual	Rayfield	Leather cone	3	Bevel	Wood, F. ...	Detach. .	11 0	4 8	14 8	9	—	—	920×120

*The 20 h.p. Mass-Paige price includes speedometer, hood, screen, five lamps, and spare rim; 25 h.p. price includes hood, screen, five electric lamps, electric engine starter, horn, speedometer, and spare rim. *Maudslay complete car prices include hood and screen. *Front tyres on the 35-40 h.p. Mercédès are 875×105 mm.; on the two 45-50 h.p. cars, the 65-70 h.p., 80-90 h.p., and the 40-45 h.p. Knight the front tyres are 915×105 mm.; with the exception of the 12-15 h.p. model all have double leather cone clutches; double-spark magnetos are fitted to the 45-50 h.p. (both models), the 65-70 h.p., and the 80-90 h.p. *15-20 h.p. Métallurgique complete car price includes one-man hood, screen, and five lamps; price of 20-40 h.p. complete car includes one-man hood, screen, C.A.V. electric lighting installation, and electric engine starter; with the exception of the 15-20 h.p. model all 1914 Métallurgique chassis are fitted with C.A.V. lighting dynamo and electric self-starter. * Meteorite prices include five lamps, horn, hood, screen, and spare wheel; price of Meteor chassis includes engine starter. *26 h.p. Minerva also supplied with a 11ft. 2in. wheelbase, and the 38 h.p. model with a 11ft. 5in. wheelbase, prices being £10 extra in each case; all Minervas have Knight engines.

The Autocars of 1914.—

H.P., Name of Car, Number of Cylinders, and Country of Origin.	Tax in Gns.	Bore and Stroke.	Cubic Capacity.	Price. Chassis with tyres.	Price. Car Complete.	No. of Seats.	Ignition	Carburetter.	Clutch.	No. of Gears	Final Drive.	Wheels	Rims.	Wheel-base.	Track.	Extreme Length	Road Clearance.	Length of Body Space.	Dash to Back Wheel Centre	Tyres.
		mm.	c.c.											ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	mm.
*10 Morris-Oxford (4) .. England	3	60 × 90	1018	£165	£180	2	Mag.	W. & P. .	Multiple disc	3	Worm	Sankey, D. ..	Fixed ..	7 0	3 6	10 6	7½	4 10	3 11	700 × 80
*10 Morris-Oxford (4) (de luxe)	3	60 × 90	1018	£180	£200	2	Mag.	W. & P. .	Multiple disc	3	Worm	Sankey, D. ..	Fixed ..	7 6	3 9	11 0	9	5 4	4 5	700 × 80
*12-15 Mors (4) (standard) F'nce	4	75 × 120	2116	£310	£365	4	Mag.	S.U.	Band	4	Bevel	Steel, D.	Fixed ..	9 7½	4 4	14 1	9 & 10½	7 4	6 7	765 × 105
*12-15 Mors (4) (de luxe) "	4	75 × 120	2116	£310	£395	5	Mag.	S.U.	Band	4	Bevel	Steel, D.	Fixed ..	9 7½	4 4	14 1	9 & 10½	7 4	6 7	765 × 105
14-16 Mors (4) (Knight) "	4	75 × 120	2116	£370	£460	5	Mag.	S.U.	Band	4	Bevel	Steel, D.	Fixed ..	9 9	4 4	14 6	9	7 6½	6 9	765 × 105
17-20 Mors (4) (de luxe) "	6	85 × 150	3393	£430	£520	5	Mag.	S.U.	Band	4	Bevel	Wood, F. ...	Fixed ..	10 6	4 10	15 0	9	8 0	7 0	880 × 120
17-20 Mors (4) (Knight) "	6	90 × 130	3307	£470	£560	5	Mag.	S.U.	Band	4	Bevel	Wood, F. ...	Fixed ..	10 6	4 10	15 0	9	8 0	7 0	880 × 120
*17-20 Mors (4) (Kn'ht) (light) "	6	90 × 130	3307	£500	—	—	Mag.	S.U.	Band	4	Bevel	Wire, D. ...	Fixed ..	10 6	4 8	—	9	—	—	880 × 120
20-30 Mors (4) (valveless) "	6	100 × 140	4396	£630	£760	5	Mag.	S.U.	Band	4	Bevel	Wood, F. ...	Fixed ..	10 6	4 10	15 0	9	8 0	7 0	880 × 120
35-40 Mors (4) (Knight) France	10	124 × 150	7232	£710	—	—	Mag.	S.U.	Band	4	Bevel	Wood, F. ...	Fixed ..	11 0	4 10	—	9	8 4	7 2	880 × 120
20-30 Mors (6) .... "	8	85 × 150	5089	£650	—	—	Mag.	S.U.	Band	4	Bevel	Wood, F. ...	Fixed ..	11 0	4 8	—	9	8 4	7 2	880 × 120
12 Motobloc (4) ...... France	4	80 × 120	2409	£310	—	—	Mag.	—	—	4	Bevel	—	—	9 1	4 6	—	8½	7 3	—	810 × 90
12 Motobloc (4) (special) "	4	80 × 148	2976	£360	—	—	Mag.	—	—	4	Bevel	—	—	9 1	4 6	—	8½	7 3	—	815 × 105
12 Motobloc (4) (long) "	4	80 × 120	2409	£310	—	—	Mag.	—	—	4	Bevel	—	—	9 1	4 6	—	8½	7 7	—	810 × 90
12 Motobloc (4) (extra long) "	4	80 × 120	2409	£315	—	—	Mag.	—	—	4	Bevel	—	—	9 9	4 6	—	8½	8 3	—	810 × 90
12 Motobloc (4) (special long) "	4	80 × 148	2976	£368	—	—	Mag.	—	—	4	Bevel	—	—	9 9	4 6	—	8½	8 3	—	815 × 105
16 Motobloc (4) (standard) "	6	90 × 130	3307	£417	—	—	Mag.	—	—	4	Bevel	—	—	10 2	4 8	—	8½	8 7	—	815 × 105
16 Motobloc (4) (special) "	6	90 × 160	4070	£442	—	—	Mag.	—	—	4	Bevel	—	—	10 2	4 8	—	8½	8 7	—	820 × 120
16 Motobloc (6) (standard) "	6	80 × 120	3614	£450	—	—	Mag.	—	—	4	Bevel	—	—	10 6	4 8	—	8½	8 7	—	820 × 120
20 Motobloc (6) (special) "	6	80 × 148	4464	£510	—	—	Mag.	—	—	4	Bevel	—	—	10 6	4 8	—	8½	8 7	—	820 × 120
N.A.G. (4) .... Germany	4	75 × 85	1500	£250	£310	2	Mag.	Own	Cone	3	Bevel	Wood, F. ...	Fixed ..	9 2	4 6¾	13 0	7½	7 10	7 0	760 × 90
N.A.G. (4) .... "	4	75 × 118	2080	£310	£375	2	Mag.	Own	Cone	4	Bevel	Wood, F. ...	Fixed ..	9 8	4 6¾	13 6	7	8 0	7 0	815 × 105
N.A.G. (4) .... "	6	83 × 120	2600	£410	£480	2	Mag.	Own	Cone	4	Bevel	Wood, F. ...	Fixed ..	10 5	4 8	15 0	7	8 8	7 9	820 × 120
N.A.G. (4) .... "	6	90 × 130	3307	£480	£580	2	Mag.	Own	Cone	4	Bevel	Wood, F. ...	Fixed ..	11 0	4 8	15 6	7	8 8	7 11	820 × 120
N.A.G. (4) .... "	8	115 × 125	5194	£650	£750	2	Mag.	Own	Cone	4	Bevel	Wood, F. ...	Fixed ..	11 1	4 8	15 6	7	8 10	8 0	880 × 120
N.A.G. (4) .... "	21	130 × 160	8495	£775	£875	2	Mag.	Own	Cone	4	Bevel	Wood, F. ...	Fixed ..	11 1	4 8	16 0	7	8 10	8 0	895 × 135
*15 Napier (4) .... England	6	82 × 127	2684	£350	£450	5	Mag.	Own	Multiple disc	3	Bevel	Wood, F. ...	Fixed ..	8 10	4 11½	12 8	9½	7 5½	6 6	815 × 105
*15 Napier (4) .... "	6	82 × 127	2684	£395	£495	5	Mag.	Own	Multiple disc	4	Worm	R.-W., D. ...	Fixed ..	9 10	4 8½	14 0	6½	7 7¼	7 0	815 × 105
*16-22 Napier (4) ...... "	6	89 × 127	3168	£450	£550	5	Mag.	Own	Plate	4	Worm	R.-W., D. ...	Fixed ..	10 4	4 8½	14 3½	6	8 3	7 6	820 × 120
*20 Napier (4) .... "	6	89 × 127	3168	£420	£520	5	Mag.	Own	Multiple disc	4	Worm	R.-W., D. ...	Fixed ..	9 10	4 8½	14 0	6½	7 7¼	7 0	815 × 105
*20 Napier (4) (Colonial) "	6	89 × 127	3168	£420	£520	5	Mag.	Own	Multiple disc	4	Bevel	R.-W., D. ...	Fixed ..	10 4	4 8½	14 0	10½	8 1	7 6	920 × 120
*30-35 Napier (6) ...... "	8	89 × 127	4752	£650	£835	5	Mag.	Own	Plate	3	Worm	R.-W., D. ...	Fixed ..	10 8	4 8	15 0	7	8 4	7 6	895 × 135
*30-35 Napier (6) (long) "	8	89 × 127	4752	£675	£860	5	Mag.	Own	Plate	4	Worm	R.-W., D. ...	Fixed ..	11 3½	4 8	15 4	7	8 9½	8 0	895 × 135
45 Napier (6) .... "	10	102 × 127	6840	£850	£1045	5	M. Acc.	Own	Multiple disc	3	Bevel	R.-W., D. ...	Fixed ..	11 2	4 8	16 0	8½	8 6	7 8½	895 × 135
12 Newton Bennett (4) Italy ...	3	70 × 140	2155	£275	£375	4	Mag.	Zenith ..	Plate	4	Bevel	Steel, D.	Fixed ..	9 1¾	4 4½	12 6½	9½	7 9½	6 10½	810 × 90
*20-30 Nazzaro (4) ..... Italy ...	6	100 × 140	4396	£495	£630	5	Mag.	Zenith ..	Disc	4	Bevel	Steel, D.	Fixed ..	10 6	4 5	13 7¾	8	8 0¾	7 1¼	880 × 120
30 N.E.C. (4) .... England	8	114 × 127	5186	£640	£790	5 to 7	M. Acc.	Own	Leather cone	4	Worm	Wood, F. ...	S. and C.	10 6	4 10	13 6	9½	9 11	9 11	920 × 120
40 N.E.C. (4) .... "	10	127 × 127	6436	£780	£940	5 to 7	M. Acc.	Own	Leather cone	4	Worm	Wood, F. ...	S. and C.	10 6	4 11	13 6	9½	9 11	9 11	920 × 120
20 New Pick (4) ...... England	6	90 × 127	3232	—	£150	2	Mag.	Holley ..	Fibre cone .	3	Worm	Wood, F. ...	Fixed ..	9 0	4 6	12 6	10	8 0	6 6	800 × 85
*20 New Pick (4) ...... "	6	90 × 127	3232	—	£165	4	Mag.	Holley ..	Fibre cone .	3	Worm	Wood, F. ...	Fixed ..	9 0	4 6	12 6	10	8 0	6 6	800 × 85
*15 Niclausse (4) ...... France..	4	80 × 140	2811	—	—	—	Mag.	Own	Leather cone	4	Bevel	Wood, F. ...	Detach.	10 10	4 6	—	7¾	8 0	—	815 × 105
*10-12 N.S.U. (4) ...... Germany	4	70 × 78	1201	£200	£215	2 to 4	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	7 10	3 8½	11 6	9	7 2	5 6	700 × 85
*14 N.S.U. (4) .... "	4	75 × 88	1556	£250	£275	2 to 4	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	8 8	4 1	12 6	9	—	—	760 × 90
*18 N.S.U. (4) .... "	4	80 × 104	2088	£310	£335	2 to 6	Mag.	Zenith ..	Multiple disc	4	Bevel	Wood, F. ...	Fixed ..	9 5	4 1	13 6	8	8 10	7 0	815 × 105
*20 N.S.U. (4) .... "	6	85 × 115	2608	£365	£400	2 to 6	Mag.	Zenith ..	Multiple disc	4	Bevel	Wood, F. ...	Fixed ..	10 2	4 6	15 0	8	9 6	7 7	815 × 105
*24 N.S.U. (4) ..	6	97 × 115	3400	£465	£500	2 to 7	Mag.	Zenith ..	Multiple disc	4	Bevel	Wood, F. ...	Fixed ..	10 6	4 6	15 4	8	9 8	7 8	820 × 120

*Morris-Oxford complete car prices include hood, screen, five lamps, horn, and spare wheel; the de luxe model a spare tyre as well. *Complete car prices of the 12-15 h.p. Mors (both models) include a dynamo lighting set; price of the 17-20 h.p. light chassis includes five wheels without tyres. *Complete car prices of the 15 h.p. three-speed Napier and the six-cylinder models include hood and screen; prices of the 16-22 h.p. car and the six-cylinder models include a C.A.V. lighting dynamo without lamps. *N.B. complete car price includes hood, screen, lamps, horn, and mechanical engine starter. *40 h.p. N.E.C. also supplied with a 11ft. 6in. wheelbase; the detachable rims are Shrewsbury and Challiner. *N.S.U. complete car prices are for two-seated bodies; the 14 h.p. model has 750 × 85 front tyres, and the 24 h.p. model 815 × 105.



The Autocars of 1914.—

H.P., Name of Car, Number of Cylinders, and Country of Origin.	Tax in Gns.	Bore and Stroke.	Cubic Capacity.	Price. Chassis with tyres.	Price. Car Complete.	No. of Seats.	Ignition	Carburetter.	Clutch.	No. of Gears	Final Drive.	Wheels.	Rims.	Wheel-base.	Track.	Extreme Length	Road Clearance.	Length of Body. Space.	Dash to Back Wheel Centre	Tyres.
		mm.	c.c.											ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	mm.
5-12 Opel (4) ....Germany	3	65 × 98	1301	£200	£240	2	Mag.	Own	Leather cone	4	Bevel	Steel	Fixed ..	8 0	4 2	11 0	10	6 10	5 10	700 × 85
5-14 Opel (4) (special) ,,	3	65 × 106	1301	£205	£258	3	Mag.	Own	Leather cone	4	Bevel	Steel	Fixed ..	8 4	4 2	11 4	10	7 3	6 0	710 × 90
6-16 Opel (4) .... ,,	4	70 × 100	1539	£260	£320	4	Mag.	Own	Leather cone	4	Bevel	Steel	Fixed ..	9 4	4 2	12 6	10	7 8	6 10	760 × 90
8-30 Opel (4) .... ,,	4	70 × 129	1986	—	£440	2	Mag.	Own	Leather cone	4	Bevel	Wire	Fixed ..	9 6	4 3	13 6	—	—	—	765 × 105
8-22 Opel (4) .... ,,	4	75 × 125	2209	£300	£390	4	Mag.	Own	Leather cone	4	Bevel	Steel	Fixed ..	10 0	4 3	13 6	10	8 8	7 8	810 × 90
10-25 Opel (4) .... ,,	6	84 × 118	2616	£400	£510	4	Mag.	Own	Leather cone	4	Bevel	Steel	Fixed ..	11 3	4 6	16 6	11	7 2	8 0	815 × 105
14-30 Opel (4) .... ,,	6	90 × 135	3435	£450	£565	4	Mag.	Own	Leather cone	4	Bevel	Steel	Fixed ..	11 3	4 6	16 6	11	9 2	8 0	820 × 120
18-40 Opel (4) .... ,,	8	105 × 135	4676	£550	£670	6	Dual	Own	Leather cone	4	Bevel	Steel	Fixed ..	11 3	4 8	16 6	11	9 2	8 0	880 × 120
25-55 Opel (4) .... ,,	10	120 × 144	9744	£675	£825	6	Dual	Own	Leather cone	4	Bevel	Steel	Fixed ..	12 4	4 10	17 0	12	9 4	8 0	935 × 135
34-80 Opel (4) .... ,,	21	130 × 165	12978	£725	£875	6	Dual	Own	Leather cone	4	Bevel	Steel	Fixed ..	12 4	4 10	17 0	12	9 4	8 0	935 × 135
40-100 Opel (4) .... ,,	21	140 × 165	15216	£775	£925	6	Dual	Own	Leather cone	4	Bevel	Steel	Fixed ..	12 0	4 10	16 0	12	9 2	8 0	935 × 135
*20-25 Overland (4) ....U.S.A.	8	105 × 115	3983	£215	£245	5	Dual	Schebler	Leather cone	3	Bevel	Wood, D. ...	Fixed ..	9 6	4 8½	—	—	—	—	815 × 105
*10-18 Palladium (4) ...England	3	65 × 130	1843	—	£298	4	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, D. ...	Fixed ..	9 6	4 8	13 0	7	—	—	710 × 90
*12-22 Palladium (4) ... ,,	4	75 × 130	2116	—	£348	4	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, D. ...	Fixed ..	9 6	4 8	13 0	7	—	—	760 × 90
*18-30 Palladium (4) ... ,,	6	94 × 132	3772	£330	£394	—	Mag.	Zenith ..	Multiple disc	3	Bevel	Wood, D. ...	Fixed ..	11 0	4 8	14 6	8	—	—	820 × 120
*12 Panhard (4) ....France..	4	70 × 140	2155	£300	£395	4	Mag.	Krebs ..	Fibre plate .	4	Bevel	Dunlop, D. ..	Fixed ..	9 2	4 5½	12 6¾	6	7 5	6 6¾	760 × 90
*15 Panhard (4) .... ,,	4	80 × 120	2409	£350	£450	5	Mag.	Krebs ..	Fibre plate .	4	Bevel	Dunlop, D. ..	Fixed ..	10 3	4 6½	13 9½	7	8 2½	7 4½	815 × 105
*28 Panhard (4) (Knight) ,,	8	105 × 140	4844	£590	—	7	Mag.	Krebs ..	Fibre plate .	4	Bevel	Dunlop, D. ..	Fixed ..	11 4½	4 8	15 1	9	9 0	8 2¼	880 × 120
*35-45 Panhard (4) (Knight) ,,	10	125 × 150	7363	£800	—	7	Mag.	Krebs ..	Fibre plate .	4	Bevel	Dunlop, D. ..	Fixed ..	11 4½	4 8	15 1	9	9 0	8 2¼	895 × 135
Perry (2) ....England	2	72 × 108	879	£127	£147	2	Mag.		Metal	3	Bevel	Sankey, D. ..	Fixed ..	7 0	3 8	10 3	7	7 0	5 1½	700 × 80
Peugeot (4) ....France..	3	55 × 90	856	—	£170	2	Mag.	Zenith ..	Leather cone	3	Bevel	Wire, F.	Fixed ..	6 0	3 5	8 0	—	—	—	550 × 65
Peugeot (4) .... ,,	3	68 × 130	1888	£300	£345	4	Mag.	Claudel..	Leather cone	4	Spur	Wood, F. ...	Fixed ..	8 3	4 0	10 7	—	—	—	760 × 90
Peugeot (4) .... ,,	4	70 × 130	2001	£315	£380	4	Mag.	Claudel	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 1	4 1	12 8	—	7 4	—	810 × 90
Peugeot (4) .... ,,	4	80 × 140	2811	£390	£480	5	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 6	4 7	14 0	—	8 4	—	815 × 105
Peugeot (4) (sporting) ,,	6	95 × 160	4536	£545	£630	4	Mag.	Claudel..	Leather cone	4	Bevel	R.-W., D. ...	Fixed ..	10 11	4 7	14 6	—	8 4	—	880 × 120
Peugeot (4) .... ,,	6	95 × 160	4536	£525	£635	5	Mag.	Claudel..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	11 6	4 10	15 2	—	—	—	880 × 120
Peugeot (4) (long).. ,,	6	95 × 160	4536	£560	£675	5	Mag.	Claudel..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	11 10	4 10	15 6	—	—	—	880 × 120
Peugeot (4) .... ,,	8	115 × 180	7479	£825	£1000	5	Mag.	Claudel..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	12 0	4 10	15 8	—	—	—	880 × 120
Peugeot (4) (sporting) ,,	8	115 × 180	7479	£825	£925	5	Mag.	Claudel..	Leather cone	4	Bevel	R.-W., D. ...	Fixed ..	11 2	4 10	15 0	—	—	—	880 × 120
8.3 Phanomobile (2) ..Germany	20s.	82 × 84	888	£105	£120	2	Mag.	Own	Metal	2	Chain	Wire, F.	Fixed ..	6 0	4 3	8 10	10	—	—	650 × 80
10-12 Phanomobile (2) ,,	20s.	82 × 110	1160	£140	£167	2	Mag.	Own	Metal	2	Chain	—	Fixed ..	6 7	4 3	9 3	12	—	—	700 × 85
14 Phanomobile (4) ... ,,	20s.	74 × 90	1548	£170	£195	3	Mag.	Own	Metal	2	Chain	—	Fixed ..	7 6	4 3	10 6	12	—	—	700 × 85
14 Phanomobile (4) ... ,,	20s.	74 × 90	1548	£170	£216	4	Mag.	Own	Metal	2	Chain	—	Fixed ..	7 6	4 3	10 6	12	—	—	700 × 85
*11.9 Phœnix (4) ......England	3	69 × 100	1496	£195	£230	3	Mag.	Stewart .	Metal	3	Worm	Wood, D. ...	Fixed ..	8 0	4 2	11 3	9	7 4	5 6½	750 × 85
*11.9 Phœnix (4) ...... ,,	3	69 × 100	1496	£220	£285	4 or 5	Mag.	Stewart .	Metal	3	Worm	Wood, D. ...	Fixed ..	9 6	4 2	14 1	9⅜	8 11	7 0	760 × 90
16-20 Piccard-Pictet (4) Switz'nd	4	80 × 140	2811	£392	—	—	Mag.	Zenith ..	Mult. plate .	4	Bevel	R.-W., D. ...	Fixed ..	10 6	4 8	14 4	8	8 6	7 8	815 × 105
*16-20 Piccard-Pictet (4) ,,	6	85 × 130	2938	£480	—	—	Mag.	Zenith ..	Mult. plate .	4	Bevel	R.-W., D. ...	Fixed ..	10 8	4 8	14 6	9	8 8	7 10	815 × 105
20-30 Piccard-Pictet (4) ,,	6	90 × 170	4328	£520	—	—	Mag.	Zenith ..	Leather cone	4	Bevel	R.-W., D. ...	Fixed ..	11 2	4 8	15 1	8	8 11	7 11	880 × 120
20-30 Piccard-P. (4) (sport'g) ,,	6	90 × 170	4328	£540	—	—	Mag.	Zenith ..	Leather cone	4	Bevel	R.-W., D. ...	Fixed ..	10 6	4 8	14 5	8	8 3	7 8	880 × 120
*30-40 Piccard-Pictet (4) ,,	6	100 × 150	4704	£660	—	—	Mag.	Zenith ..	Mult. plate .	4	Bevel	R.-W., D. ...	Fixed ..	10 11	4 8	15 5	9	8 11	7 7	880 × 120
*30-40 Piccard-P. (4) (sport'g) ,,	6	100 × 150	4704	£660	—	—	Mag.	Zenith ..	Mult. plate .	4	Bevel	R.-W., D. ...	Fixed ..	10 1	4 8	14 3	9	8 3	7 0	880 × 120
*38 Pierce-Arrow (6) ...U.S.A.	10	102 × 140	6864	£785	£950	2 to 5	M. Acc.	Own	Leather cone	4	Bevel	Wood, F. ...	Detach.	10 7	4 8	14 9	—	—	—	915 × 114
48 Pierce-Arrow (6) ... ,,	21	114 × 140	8574	—	£1060	2 to 7	M. Acc.	Own	Leather cone	4	Bevel	Wood, F. ...	Detach.	11 3½	4 8	15 10	—	—	—	940 × 127
66 Pierce-Arrow (6) ... ,,	21	127 × 178	13530	—	£1260	2 to 7	M. Acc.	Own	Leather cone	4	Bevel	Wood, F. ...	Detach.	11 8	4 9	16 5	—	—	—	940 × 127

*Overland complete car price includes hood, screen, six electric lamps, and electric horn. *Palladium complete car prices include lamps and horn; there is also a Grand Prix Palladium model, four cylinders, 69.5 × 120 mm., chassis price £225 without tyres. *The 12 h.p. and 15 h.p. Panhards are fitted with Krebs two-jet carburetters, the 28 h.p. and 35 h.p. models with Krebs multi-jet carburetters; price of the 12 h.p. Panhard includes hood, screen, five lamps, and horn; the 15 h.p. car has similar equipment, and speedometer in addition. *Phœnix complete car prices include hood, screen, five lamps, horn, spare wheel and tyre, and number-plates. *These Piccard-Pictet models are fitted with Argyll single sleeve valve engines; all chassis prices include power-driven tyre inflator and exhaust whistle. *Price of the 38 h.p. Pierce-Arrow complete includes engine starter, all lamps, and hood.

E

The Autocars of 1914.—

H.P., Name of Car, Number of Cylinders, and Country of Origin.	Tax in Gns.	Bore and Stroke.	Cubic Capacity.	Price. Chassis with tyres.	Price. Car Complete.	No. of Seats.	Ignition	Carburetter.	Clutch.	No. of Gears	Final Drive.	Wheels.	Rims.	Wheelbase.	Track.	Extreme Length	Road Clearance.	Length of Body Space.	Dash to Back Wheel Centre	Tyres.
		mm.	c.c.											ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	mm.
8-10 Pilain (4) .... France..	3	55×110	1048	£200	—	—	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	8 4	4 3	—	—	7 11	—	760×90
10-12 Pilain (4) .... „	3	65×120	1593	£250	—	—	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	8 4	4 3	—	—	7 11	—	760×90
12-15 Pilain (4) .... „	4	75×110	1940	£290	—	—	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 0	4 3	—	—	8 2	—	810×90
14 Pilain (4) .... France..	4	80×140	2811	£310	—	—	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	—	—	—	—	—	—	815×105
16-20 Pilain (4) (short) „	6	90×120	3052	£330	—	—	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 2	4 3	—	—	7 8	—	810×90
16-20 Pilain (4) (medium) „	6	90×120	3052	£390	—	—	Mag.	Zenith ..	Disc	4	Bevel	Wood, F. ...	Fixed ..	9 8	4 7	—	—	8 3	—	815×105
16-20 Pilain (4) (long) . „	6	90×120	3052	£410	—	—	Mag.	Zenith ..	Disc	4	Bevel	Wood, F. ...	Fixed ..	10 3	4 7	—	—	9 0	—	815×105
20-30 Pilain (4) .... „	6	100×140	4396	£450	—	—	Mag.	Zenith ..	Disc	4	Bevel	Wood, F. ...	Fixed ..	10 3	4 7	—	—	9 0	—	820×120
24-35 Pilain (4) (short) „	8	110×180	6842	£590	—	—	Mag.	Zenith ..	Disc	4	Bevel	Wood, F. ...	Fixed ..	10 4	4 7	—	—	7 11	—	880×120
24-35 Pilain (4) (long) . „	8	110×180	6842	£650	—	—	Mag.	Zenith ..	Disc	4	Bevel	Wood, F. ...	Fixed ..	11 8	4 11	—	—	9 5	—	880×120
14 Pilain (6) .... „	4	65×130	2592	£350	—	—	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 0	4 3	—	—	7 10	—	—
*10-12 Pilgrim (2) ..... England	3	98×102	1519	£220	£275	2	Dual	W. & P. .	Metal cone..	3	Bevel	Steel, F.	Fixed ..	8 0	4 4	12 0	8¼	7 7½	6 4½	810×90
*10 Pilot (4) .... England	3	60×110	1245	£135	£150	2	Mag.	Zenith ..	—	5	Chain	Wire, F.	Fixed ..	7 0	4 0	10 1	7	4 11	4 4	700×80
*12-16 Pipe (4) .... Belgium	4	75×120	2116	£296	—	—	Mag.	—	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 7½	4 2	12 10½	—	8 0½	—	815×105
*12-16 Pipe (4) (sporting) „	4	75×120	2116	£304	—	—	Mag.	—	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 7½	4 2	12 10½	—	8 0½	—	815×105
*16-20 Pipe (4) .... „	4	80×150	3012	£380	—	—	Mag.	—	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 3⅛	4 6¼	14 0⅛	—	8 4½	—	820×120
*24-30 Pipe (4) .... „	6	100×180	5664	£540	—	—	Mag.	—	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	11 3¾	4 9⅛	15 4	—	8 10¼	—	880×120
*24-30 Pipe (4) (sporting) „	6	100×180	5664	£560	—	—	Mag.	—	Leather cone	4	Bevel	Wire, D.	Fixed ..	10 6	4 7⅛	14 3¼	—	7 10½	—	880×120
*60-80 Pipe (4) .... „	10	120×200	9048	£1000	—	—	Mag.	—	Disc	4	Bevel	Wood, F. ...	Vinet ...	12 2¾	4 9⅛	16 8¼	—	9 6⅛	—	880×120
*60-80 Pipe (4) (sporting) „	10	120×200	9048	£1000	—	—	Mag.	—	Disc	4	Bevel	Wire, D.	Fixed ..	11 5¾	4 7⅛	15 6½	—	8 2½	—	895×135
* 9.5 Portland (4) ..... England	3	56×76	749	—	£135	2	Mag.	Sthenos .	Leather cone	3	Bevel	Wire, F.	Fixed ..	7 3	4 0	10 3	10	—	—	650×65
*12-16 Portland (4) .... „	4	70×90	1385	£160	£175	2	Mag.	Sthenos .	Leather cone	3	Bevel	Wire, F.	Fixed ..	8 4	4 0	12 0	10	6 0	5 6	710×90
8 Ranger (2) .... England	3	85×85	964	£111	£121	2	Mag.	Polyrhoe	Leather cone	2	Chain	Wire, F.	Fixed ..	7 3	3 10	9 10	10	6 6½	5 6	650×65
* R.C.H. (4) .... U.S.A.	4	80×127	2550	—	£225	2 to 5	Mag.	B.D. ...	Leather cone	3	Bevel	Wood, F. ...	Detroit..	9 2	4 8	12 3	10½	—	—	840×90
9 Renault (2) (short) . France..	3	80×120	1205	£173	£206	2	Mag.	Own	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	7 9¼	3 9¼	10 10¼	6¼	6 6¾	4 5	710×90
9 Renault (2) (long) .. „	3	80×120	1205	£234	—	—	Mag.	Own	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	8 5¾	4 4	12 3½	7¼	8 0½	5 2½	810×90
*13.9 Renault (4) ...... „	4	75×120	2116	£306	£374	4	Mag.	Own	Leather cone	3	Bevel	Detach.	Fixed ..	9 10¼	4 4¾	13 9¾	7½	8 0½	5 9	810×90
*15.8 Renault (4) ...... „	4	80×130	2610	£374	£446	4	Mag.	Own	Leather cone	4	Bevel	Detach.	Fixed ..	10 0½	4 4¾	14 2	6¼	8 0½	5 9	815×105
*20.1 Renault (4) ...... „	6	90×140	3561	£534	—	—	Mag.	Own	Leather cone	4	Bevel	Detach.	Fixed ..	11 1¾	4 9¼	15 4½	7¼	8 6¼	6 2¾	880×120
*22.4 Renault (4) ...... „	6	95×160	4536	£554	—	—	Mag.	Own	Leather cone	4	Bevel	Detach.	Fixed ..	11 8	4 9¼	15 10¾	6¼	8 8¼	—	880×120
*24.8 Renault (4) ...... „	6	100×160	5027	£598	—	—	Mag	Own	Leather cone	4	Bevel	Detach.	Fixed ..	11 10¾	4 9¼	16 1½	7	9 0¼	6 6¾	880×120
*45 Renault (4) .... „	21	130×160	8495	£770	—	—	Mag.	Own	Leather cone	4	Bevel	Detach.	Fixed ..	12 3½	4 9¼	16 6¼	6¾	9 0¼	6 7	920×120
*26.9 Renault (6) ...... „	8	85×150	5089	£630	—	—	Mag.	Own	Leather cone	4	Bevel	Detach.	Fixed ..	11 11¼	4 9¼	16 2¼	6	8 8¼	6 7	880×120
*37.2 Renault (6) ...... „	10	100×160	7541	£910	—	—	Mag.	Own	Leather cone	4	Bevel	Detach.	Fixed ..	12 3¼	4 11	16 6¼	6½	8 8¼	6 7	935×135
10 Riley (2) (V engine) England	3	96×96	1390	£214	£231	2 or 3	Mag.	Zenith ..	Leather cone	3	Bevel	Wire, D.	Fixed ..	8 0	4 5	11 9	9½	7 2	5 7	800×85
12 Riley (2) (V engine) „	4	102×127	2058	£277	£300	2 or 3	Mag.	Zenith ..	Leather cone	3	Bevel	Wire, D.	Fixed ..	9 2	4 5	13 2	9½	8 4	6 10	810×90
12 Riley (2) (V engine) „	4	102×127	2058	£277	£341	5	Mag.	Zenith ..	Leather cone	3	Bevel	Wire, D.	Fixed ..	9 2	4 5	13 2	9½	8 4	6 10	810×90
17 Riley (4) .... „	6	86×127	2951	£355	£430	2 or 3	Mag.	Zenith ..	Leather cone	3	Worm	Wire, D.	Fixed ..	10 4	4 9	13 0	9½	8 4	7 3	875×105
17 Riley (4) .... „	6	86×127	2951	£355	£450	5	Mag.	Zenith ..	Leather cone	3	Worm	Wire, D.	Fixed ..	10 4	4 9	—	—	—	—	—
15 Rochet-Schneider (4) France	4	80×130	2610	£364	£500	5	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 11	4 5	13 10	—	8 2	5 11	815×105
18 Rochet-Schneider (4) „	6	95×140	3964	£501	£650	7	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	11 0	4 9	15 2	—	8 10	6 7	880×120
30-40 Rochet-Schneider (4) „	8	110×140	5322	£613	£775	7	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	11 6	4 9	15 8	—	8 10	6 7	895×135
40-60 Rochet-Schneider (4) „	10	120×160	7238	£915	£1075	7	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	—	—	—	—	—	—	895×135
18 Rochet-Schneider (6) „	6	80×120	3614	£578	£725	7	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	11 3	4 5	15 0	—	8 10	6 7	880×120
28-37 Rochet-Schneider (6) „	10	95×130	5520	£706	£860	7	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	11 9	4 7	15 4	—	8 10	6 7	895×135
10 Rolland-Pilain (4) .. France	4	70×125	1924	—	£350	4	Mag.	Claudel..	Leather cone	4	Bevel	R.W. D.	—	—	—	—	—	—	—	760×90
14 Rolland-Pilain (4) .. „	6	85×140	3167	—	—	4	Mag.	Claudel..	Leather cone	4	Bevel	—	—	—	—	—	—	—	—	815×105
18 Rolland-Pilain (4) .. „	6	95×140	3964	—	—	4	Mag.	Claudel..	Leather cone	4	Bevel	—	—	—	—	—	—	—	—	880×120

*The Pilgrim is front-wheel driven, and is fitted with a horizontally opposed engine. *The Pilot is friction driven. *Pipe prices do not include tyres; rims for twin tyres are fitted to the back wheels of the first of the 60-80 h.p. models. *Portland complete car prices include hood, screen, lamps, horn, and dashboard mirror; price of 12-16 h.p. model with four-seated body is £215. *R.C.H. price includes five lamps, hood, screen, speedometer, horn, and spare rim. *All prices quoted for four-cylinder and six-cylinder Renaults include a lighting dynamo.

The Autocars of 1914.—

H.P., Name of Car, Number of Cylinders, and Country of Origin.	Tax in Gns.	Bore and Stroke.	Cubic Capacity.	PRICE. Chassis with tyres.	PRICE. Car Complete.	No. of Seats.	Ignition.	Carburetter.	Clutch.	No. of Gears.	Final Drive.	Wheels.	Rims.	Wheelbase.	Track.	Extreme Length	Road Clearance.	Length of Body Space.	Dash to Back Wheel Centre	Tyres.
		mm.	c.c.											ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	mm.
40-50 Rolls-Royce (6) .. England	21	114 × 121	7411	£985	£1145	5	M. Acc.	Own	Fabric cone	3	Bevel	Wood, F. ...	Fixed ..	11 11½	4 8	16 0	8¼	8 6	7 8	895 × 135
12-16 Rossel (4) ...... France ..	4	75 × 150	2651	£265	—	2 to 4	Mag.	Zenith ..	Leather cone	4	Bevel	—	—	9 0	4 4	—	10	—	—	760 × 90
15 Rothwell (4) ...... England	4	79 × 127	2490	£285	£350	4	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	9 0	4 3	12 6	8½	7 10	6 9	815 × 105
20 Rothwell (4) ...... "	6	102 × 127	4227	£300	£365	4	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	9 6	4 3	13 0	8½	7 10	6 9	815 × 105
*12 Rover (4) .... England	4	75 × 130	2298	£251	£331	2	Mag.	S.U.	Disc	3	Worm	Wood, D. ...	Fixed ..	9 2	4 2	13 7	6½	7 7	6 8	810 × 90
*12 Rover (4) .... "	4	75 × 130	2298	£251	£350	4	Mag.	S.U.	Disc	3	Worm	Wood, D. ...	Fixed ..	9 8	4 2	14 1	6½	8 1¼	7 2¼	810 × 90
*12 Rover (4) (Colonial) "	4	75 × 130	2298	£275	£375	4	Mag.	S.U.	Disc	3	Worm	Sankey, D. ..	Fixed ..	9 8	4 8½	14 2	11½	8 1¼	7 2¼	910 × 90
* 8.1 Salmon (4) ...... England	3	56 × 76	749	£125	£158	2 or 3	Mag.	Sthenos .	Leather cone	3	Worm	Wood, F. ...	Fixed ..	7 2	3 9	10 0	10	6 9	—	700 × 85
*11.9 Salmon (4) ...... "	3	69 × 90	1343	£145	£185	2 or 3	Mag.	Sthenos .	Leather cone	3	Worm	Wood, F. ...	Fixed ..	8 0	3 9	11 3	10	8 0	—	750 × 85
*14-18 Sava (4) (short) . Belgium	4	75 × 140	2474	£315	£430	5	Mag.	Zenith ..	Leather cone	4	Worm	Wood, F. ...	Fixed ..	9 10½	4 5	13 8	8	8 0½	7 2¼	815 × 105
*14-18 Sava (4) (long) .. "	4	75 × 140	2474	£335	£450	5	Mag.	Zenith ..	Leather cone	4	Worm	Wood, F. ...	Fixed ..	10 8	4 5	14 4	8	8 8½	7 10	815 × 105
*18-26 Sava (4) (short) . "	6	82 × 140	2960	£400	£515	5	Mag.	Zenith ..	Leather cone	4	Worm	Wood, F. ...	Fixed ..	10 6	4 5	14 4½	8	8 6½	7 8	820 × 120
*18-26 Sava (4) (long) .. "	6	82 × 140	2960	£425	£540	5	Mag.	Zenith ..	Leather cone	4	Worm	Wood, F. ...	Fixed ..	11 2	4 5	15 0	8	9 2½	8 4	820 × 120
*24-30 Sava (4) (sporting) "	6	85 × 140	3167	£415	£530	4	Mag.	Zenith ..	Leather cone	4	Worm	Wood, F. ...	Fixed ..	10 1	4 6	13 10½	7	7 10½	7 0½	815 × 105
*36-50 Sava (4) (short) . "	8	110 × 160	6082	£526	£641	5	Mag.	Zenith ..	Leather cone	4	Worm	Wood, F. ...	Fixed ..	11 2½	4 8	15 1½	8	8 6½	7 8	880 × 120
*36-50 Sava (4) (long) .. "	8	110 × 160	6082	£546	£661	5	Mag.	Zenith ..	Leather cone	4	Worm	Wood, F. ...	Fixed ..	11 10½	4 8	15 9½	8	8 6½	8 4	880 × 120
*20-30 Scacchi (4) (short) Italy	6	100 × 150	4704	£485	£550	—	Mag.	Own	Plate	4	Bevel	Wire, D.	Fixed ..	9 9½	—	13 4	7½	8 2	7 2	880 × 120
*20-30 Scacchi (4) (long) "	6	100 × 150	4704	£485	—	—	Mag.	Own	Plate	4	—	Wire, D.	Fixed ..	10 4	—	14 0	7½	8 8¾	7 9	—
*20-30 Scacchi (4) (ext. long) "	6	100 × 150	4704	£485	—	—	Mag.	Own	Plate	4	Bevel	Wire, D.	Fixed ..	10 7½	—	14 3	7½	9 0	8 0½	—
*24-80 Scacchi (4) ...... "	6	100 × 200	6283	£545	£600	—	Mag.	Own	Plate	4	Bevel	Wire, D.	Fixed ..	—	—	—	—	—	—	880 × 120
*11.9 S.C.A.R. (4) .....France..	3	69 × 140	2094	—	£300	4	Mag.	Zenith ..	Hele-Shaw .	4	Bevel	Detach.	Fixed ..	—	—	—	—	—	—	—
*15.9 S.C.A.R. (4) ..... "	4	80 × 140	2811	—	£410	2	Mag.	Zenith ..	Hele-Shaw .	4	Bevel	Detach.	Fixed ..	10 3	4 6	14 3	9½	8 0	7 0	815 × 105
*15.9 S.C.A.R. (4) ..... "	4	80 × 140	2811	—	£425	4	Mag.	Zenith ..	Hele-Shaw .	4	Bevel	Detach.	Fixed ..	10 3	4 6	14 3	9½	8 0	7 0	815 × 105
*15.9 S.C.A.R. (4) (long) "	4	80 × 140	2811	—	£430	4	Mag.	Zenith ..	Hele-Shaw .	4	Bevel	Detach.	Fixed ..	11 0	4 6	15 0	9½	8 9	7 9	815 × 105
*17.9 S.C.A.R. (4) ..... "	6	85 × 140	3167	—	£435	4	Mag.	Zenith ..	Hele-Shaw .	4	Bevel	Detach.	Fixed ..	10 3	4 6	14 3	9½	8 0	7 0	815 × 105
*15-20 S.C.A.T. (4) ....Italy ...	6	85 × 130	2938	£335	£465	5	Mag.	Zenith ..	Disc	4	Bevel	Steel, D.	Fixed ..	9 9	4 3	13 3½	9½	8 0½	6 2⅞	815 × 105
*20-30 S.C.A.T. (4) .... "	6	100 × 140	4396	£435	£585	5	Mag.	Zenith ..	Disc	4	Bevel	Steel, D.	Fixed ..	10 6	4 5	14 4	8	8 6½	7 8½	880 × 120
11.9 Scout (4) .... England	3	69 × 125	1868	£245	—	4	Mag.	Own	Cone	4	B or W	Sankey, D. ..	Fixed ..	9 0	4 3	—	—	7 11	6 10	760 × 90
15.9 Scout (4) .... "	4	80 × 130	2610	£285	—	4	Mag.	Own	Cone	4	Bevel	Sankey, D. ..	Fixed ..	9 5	4 3	—	—	7 11	6 10	810 × 90
19.6 Scout (4) .... "	6	90 × 140	3561	£380	—	4	Dual	Own	Cone	4	Bevel	Sankey, D. ..	Fixed ..	9 8	4 8	—	—	8 3	6 10	815 × 105
25.6 Scout (4) .... "	6	102 × 140	4576	£440	—	4	Dual	Own	Cone	4	Bevel	Sankey, D. ..	Fixed ..	9 8	4 8	—	—	8 3	6 10	820 × 120
*10-14 Schneider, Th. (4) France	4	70 × 120	1843	£300	£365	3	Mag.	Claudel..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 8	4 4	12 10	10	—	—	765 × 105
*12-15 Schneider, Th. (4) "	4	75 × 130	2298	£325	£385	3	Mag.	Claudel..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 10	4 4	13 8	10	—	—	815 × 105
*15-20 Schneider, Th. (4) "	4	80 × 140	2811	£375	£470	5	Mag.	Claudel..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 4	4 6	14 4	10	—	—	820 × 120
*16-20 Schneider, Th. (4) "	6	82 × 140	2960	£450	£535	5	Mag.	Claudel..	Leather cone	4	Bevel	Wire, D.	Fixed ..	10 0	4 4	—	10	—	—	820 × 120
*18-22 Schneider, Th. (4) "	6	95 × 140	3964	£500	£595	5	Mag.	Claudel..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	11 0	4 8	14 10	10	—	—	880 × 120
*22.8 Schneider, Th. (4) . "	6	96 × 150	4343	£750	£850	5	Mag.	Claudel..	Leather cone	4	Bevel	Wire, D.	Fixed ..	10 8	4 6	—	10	—	—	820 × 120
*28-35 Schneider, Th. (4) "	8	110 × 160	6082	£650	£750	5	Mag.	Claudel..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	11 10	4 8	15 8	10	—	—	880 × 120
*20-25 Schneider, Th. (6) "	6	75 × 120	3174	£515	£615	5	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 6	4 6	15 3	10	—	—	820 × 120
*18-20 Seabrook R.M.C. (4) U.S.A.	6	95 × 114	3232	—	£285	5	Dual	—	Leather cone	3	Bevel	Wood, F. ...	Detach.	9 0	4 8	—	—	—	—	—
*30 Sheffield-Simplex (6) England	8	89 × 127	4741	£885	—	—	Mag.	Own	Multiple disc	4	Worm	R.-W., D. ...	Fixed ..	12 0	4 11	16 3	8¼	9 3⅜	8 2¼	935 × 135

*Rover complete car prices include hood, screen, electric lighting set with five lamps, horn, spare wheel and tyre; the four-seated car for home use can also be supplied with a 9ft. 2in. wheelbase. *Salmon complete car prices include hood, screen, lamps, and horn. *Sava complete car prices include hood with side curtains, screen, number-plates, and three lamps. *Scacchi prices include spare wheel; the Zenith carburetter can be fitted if desired. *The two-seated 15.9 h.p. S.C.A.R. also has a dickey seat; all prices include a spare wheel and tyre, hood, screen, lamps, horn, and number-plates. *S.C.A.T. complete car prices include hood, screen, lamps, horn, and N.B. engine starter and tyre inflator. *Schneider complete car prices include hood, screen, and lamps. *Price of Seabrook R.M.C. car includes dynamo lighting set with five lamps, engine starter, one-man hood and side curtains, screen, speedometer, spare rim and tyre. *Sheffield-Simplex price includes electric engine starter and lighting outfit with all lamps, electric horn, scuttle dash with mounted instrument board containing clock, speedometer, and gauges, also spare wheel.

The Autocars of 1914.—

H.P., Name of Car, Number of Cylinders, and Country of Origin.	Tax in Gns.	Bore and Stroke.	Cubic Capacity.	Price. Chassis with tyres.	Price. Car Complete.	No. of Seats.	Ignition	Carburetter.	Clutch.	No. of Gears	Final Drive.	Wheels.	Rims.	Wheelbase.	Track.	Extreme Length	Road Clearance.	Length of Body Space.	Dash to Back Wheel Centre	Tyres.
		mm.	c.c.											ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	mm.
*14-20 Siddeley-Deasy (4) Eng.	4	80 × 130	2610	£375	£500	4 or 5	Mag.	Own	Plate	4	Worm	Wire, D.	Fixed ..	10 5	4 8	13 9	10	8 0	7 7½	815 × 105
*18-24 Siddeley-D. (4) (light) „	6	90 × 130	3307	£470	£615	4 or 5	Dual	Own	Plate	4	Worm	Wire, D.	Fixed ..	10 8	4 8	13 5	8	8 9	7 11	815 × 105
*18-24 Siddeley-Deasy (4) „	6	90 × 130	3307	£475	£625	5	Dual	Own	Plate	4	Worm	Wire, D.	Fixed ..	10 10	4 8	13 7	8	8 9	7 11	820 × 120
*30-36 Siddeley-Deasy (6) „	8	90 × 130	4961	£685	£850	5	Dual	Own	Plate	4	Worm	Wire, D.	Fixed ..	11 6	4 8	14 8	8	8 9	7 11	895 × 135
*10 Singer (4) .... England	3	63 × 88	1096	—	£195	2	Mag.	Claudel..	Leather cone	3	Bevel	Steel, D.	Fixed ..	7 6	3 6	10 6	7½	—	—	700 × 80
*14 Singer (4) .... „	4	78 × 125	2384	£315	£375	4	Mag.	Claudel..	Leather cone	4	Bevel	Steel, D.	Fixed ..	9 3	4 0½	12 10	9	7 10½	6 8	810 × 90
*15 Singer (4) .... „	4	80 × 130	2610	£370	£430	5	Mag.	Claudel..	Leather cone	4	Bevel	Steel, D.	Fixed ..	9 9	4 6	13 9	7	7 10½	6 11½	815 × 105
*20 Singer (4) (short) ... „	6	90 × 130	3307	£425	£485	5	Mag.	Claudel..	Leather cone	4	Bevel	Steel, D.	Fixed ..	9 9	4 6	13 9	7	7 10½	6 11½	815 × 105
*20 Singer (4) (long) ... „	6	90 × 130	3307	£435	£585	5	Mag.	Claudel..	Leather cone	4	Bevel	Steel, D.	Fixed ..	11 0	4 6	15 0	7	9 1½	8 2½	820 × 120
*15-25 Sirron (4) ...... England	4	80 × 120	2409	£290	£335	2	Mag.	Solex ...	Leather cone	3	Bevel	Wood, F. ...	Captain	9 3	4 5	13 0	8⅜	7 10	6 10	810 × 90
*15-25 Sirron (4) ...... „	4	80 × 120	2409	—	£350	4	Mag.	Solex ...	Leather cone	3	Bevel	Wood, F. ...	Captain	9 3	4 5	13 0	8⅜	7 10	6 10	810 × 90
20 Sizaire-Berwick (4) . France..	6	90 × 160	4070	£475	£650	5	Mag.	Four-jet	Multiple disc	4	Bevel	R.-W., D. ...	Fixed ..	11 3	4 8	15 0	9½	—	—	820 × 120
*10-12 Sizaire-Naudin (4) France	3	65 × 120	1593	£236	£299	2	Mag.	Zenith ..	Leather cone	3	Bevel	Sankey, D. ..	Fixed ..	8 10	4 4¼	12 3	8⅝	6 6½	5 8	710 × 90
*10-12 Sizaire-Naudin (4) „	3	65 × 120	1593	£236	£315	4	Mag.	Zenith ..	Leather cone	3	Bevel	Sankey, D. ..	Fixed ..	8 10	4 4¼	12 3½	8⅝	6 10½	5 8	710 × 90
*12-15 Sizaire-Naudin (4) „	4	75 × 120	2116	£267	£347	2	Mag.	Zenith ..	Leather cone	3	Bevel	Sankey, D. ..	Fixed ..	10 0	4 4	13 6½	8⅝	7 6	6 8⅝	760 × 90
*12-15 Sizaire-Naudin (4) „	4	75 × 120	2116	£267	£368	4	Mag.	Zenith ..	Leather cone	3	Bevel	Sankey, D. ..	Fixed ..	10 0	4 4	13 6½	8⅝	7 10¼	6 8⅝	760 × 90
*12-15 Sizaire-N. (4) (long) „	4	75 × 130	2298	£299	£373	2	Mag.	Zenith ..	Leather cone	4	Bevel	Sankey, D. ..	Fixed ..	10 1	4 4	13 2	9¾	7 6	6 7⅞	765 × 105
*12-15 Sizaire-N. (4) (long) „	4	75 × 130	2298	£299	£394	4	Mag.	Zenith ..	Leather cone	4	Bevel	Sankey, D. ..	Fixed ..	10 1	4 4	13 9	9¾	7 10¼	6 7⅞	765 × 105
*18-30 Sizaire-Naudin (4) „	4	70 × 170	2616	£346	£415	2	Mag.	Zenith ..	Leather cone	4	Bevel	R.-W., D. ...	Fixed ..	10 1	4 4	13 9	8½	7 2	6 1¾	765 × 105
*18-30 Sizaire-Naudin (4) „	4	70 × 170	2616	£346	£425	4	Mag.	Zenith ..	Leather cone	4	Bevel	R.-W., D. ...	Fixed ..	10 1	4 4	13 9	8½	7 10	6 1¾	765 × 105
*18-30 Sizaire-N. (4) (long) „	4	70 × 170	2616	£326	£405	2	Mag.	Zenith ..	Single plate	3	Bevel	R.-W., D. ...	Fixed ..	10 2	4 7	13 6	7⅝	8 6	6 4⅜	815 × 105
*18-30 Sizaire-N. (4) (long) „	4	70 × 170	2616	£326	£415	4	Mag.	Zenith ..	Single plate	3	Bevel	R.-W., D. ...	Fixed ..	10 2	4 7	13 6	7⅝	8 6	6 4⅜	815 × 105
*20 Sizaire-Naudin (4) .. „	4	80 × 150	3012	£362	£441	2	Mag.	Zenith ..	Leather cone	4	Bevel	R.-W., D. ...	Fixed ..	10 2	4 6	13 10⅞	7⅛	7 2	6 6¼	815 × 105
*20 Sizaire-Naudin (4) .. „	4	80 × 150	3012	£362	£452	4	Mag.	Zenith ..	Leather cone	4	Bevel	R.-W., D. ...	Fixed ..	10 2½	4 6	13 10⅞	7⅛	7 6	6 6¼	815 × 105
12-15 S.P.A. (4) ...... Italy	4	70 × 120	1843	£335	£435	5	Mag.	—	Multiple disc	4	Bevel	—	—	—	—	—	—	7 9	—	810 × 90
*16-20 S.P.A. (4) ...... „	6	85 × 120	2714	£395	£495	5	Mag.	—	Multiple disc	4	Bevel	—	—	—	—	—	—	8 2	—	815 × 105
*18-25 S.P.A. (4) ...... „	6	85 × 140	3167	£440	£540	5	Mag.	—	Multiple disc	4	Bevel	—	—	—	—	—	—	8 2	—	815 × 105
*25-30 S.P.A. (4) ...... „	6	100 × 140	4396	£525	£575	5	Mag.	—	Multiple disc	4	Bevel	—	—	—	—	—	—	7 9	—	815 × 105
*50 S.P.A. (4) .... „	8	110 × 200	7603	£715	£815	5	Mag.	—	Multiple disc	4	Bevel	—	—	—	—	—	—	8 7	—	880 × 120
*12-20 Sperber (4) ..... Germany	4	71 × 100	1570	£225	£250	4	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	9 2½	4 3½	12 10½	7½	8 9½	7 4	760 × 90
*10-15 Sperberette (4) .. „	3	64 × 100	1295	—	£190	2	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, F. ...	Fixed ..	9 2½	4 3½	—	—	—	—	700 × 85
*14 Spyker (4) .... Holland	4	80 × 120	2409	£315	—	—	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 0	4 5½	12 7	7⅞	7 10½	6 9½	760 × 90
*20 Spyker (4) .... „	6	90 × 135	3435	£430	—	—	Mag.	Zenith ..	Disc	4	Bevel	Wood, F. ...	Fixed ..	10 0	4 5½	13 9	8	8 6	7 5	820 × 120
*25 Spyker (4) .... „	8	106 × 130	4589	£500	—	—	Mag.	Zenith ..	Disc	4	Bevel	Wood, F. ...	Fixed ..	11 0	4 5	15 3	9½	9 2	8 1	880 × 120
*30 Spyker (4) .... „	8	110 × 160	6082	£625	—	—	Mag.	Zenith ..	Disc	4	Bevel	Wood, F. ...	Fixed ..	11 6	4 9	16 4	9½	9 2	8 1	880 × 120
*40 Spyker (4) .... „	10	120 × 160	7238	£710	—	—	Mag.	Zenith ..	Disc	4	Bevel	Wood, F. ...	Fixed ..	11 6	4 9	16 4	9½	9 2	8 1	880 × 120
14 Springuel (4) ...... Belgium	4	75 × 120	2116	£375	£495	5	Mag.	—	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 6	4 4	14 0	8	7 10	—	810 × 90
20 Springuel (4) ...... „	6	90 × 120	3052	£475	£595	5	Mag.	—	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 0	4 4	15 0	9	8 6	—	815 × 105
* 9.5 Standard (4) ..... England	3	62 × 90	1087	£175	£195	2	Mag.	Autom'c	Disc	3	Worm	Steel, D.	Fixed ..	7 6	4 0	10 5	9½	6 10¾	5 4¾	700 × 80
*15 Standard (4) ...... „	4	79 × 121	2368	£310	£385	4	Mag.	Autom'c	Disc	4	Worm	Steel, D.	Fixed ..	10 0	4 9	13 10	9½	9 2¾	7 2¾	815 × 105
*20 Standard (4) (short) „	6	89 × 134	3336	£375	£485	5	Mag.	Autom'c	Disc	4	Worm	Steel, D.	Fixed ..	10 1	4 9	13 11	9½	9 1	7 1	820 × 120
*20 Standard (4) (long) . „	6	89 × 134	3336	£375	—	—	Mag.	Autom'c	Disc	4	Worm	Steel, D.	Fixed ..	10 7	4 9	14 5	9½	9 7	7 7	820 × 120

*All Siddeley-Deasy cars have Knight sleeve-valve engines; complete car prices include hood, screen, and complete dynamo lighting set; chassis prices include lighting dynamo. *10 h.p. Singer price includes lamps; the 14 h.p., 15 h.p., and 20 h.p. (short) models are also listed with two-seated bodies, prices being £25 less in each case than those given. *Sirron chassis price includes spare rim; complete car prices include hood, screen, and spare rim. *Sizaire-Naudin chassis prices include spare wheel and tyre; complete car prices include hood, screen, spare wheel and tyre, five lamps, speedometer, horn, registration and number-plates; the two 18-30 h.p. long chassis are provided with gear giving a direct drive on each speed. *These S.P.A. models can be supplied with a 9in. longer wheelbase for £20 extra. *Sperberette and Sperber cars are fitted with chain-driven gear boxes; price of the complete Sperber car includes hood, screen, and lamps. *Spyker prices do not include tyres. *Standard complete car prices include five lamps, hood, screen, horn, and spare wheel and tyre.

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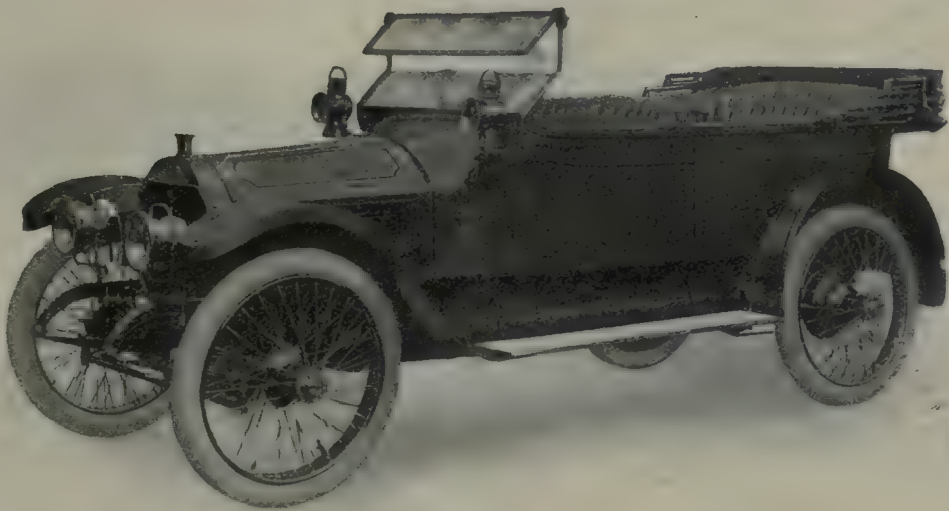

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15 h.p.,	8′ 10″	wheelbase,	£350	20 h.p.,	9′ 10″	wheelbase,	£420
15 h.p.,	9′ 10″	,,	£395	*30-35 h.p.,	10′ 8″	,,	£650
*16-22 h.p.,	10′ 4″	,,	£450	*45 h.p.,	11′ $6\frac{1}{4}$″	,,	£850

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In every country Austin cars are to be seen—in every country the Austin name is a recognised sign of car quality and real car value. Climatic conditions do not affect them, and in the case of the special models intended for the Colonies and abroad, the materials used are particularly adapted for varying climates. Complete with all the successful details that have made Austin's famous at home are many features such as specially high ground clearance where this is desirable, additional axle strength, and many other details, the outcome of our practical experience in building Austins for service overseas.

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AGENCIES EVERYWHERE.

The Autocars of 1914.—

H.P., Name of Car, Number of Cylinders, and Country of Origin.	Tax in Gns.	Bore and Stroke.	Cubic Capacity.	Price. Chassis with tyres.	Price. Car. Complete.	No. of Seats.	Ignition	Carburetter.	Clutch.	No. of Gears	Final Drive.	Wheels.	Rims.	Wheel-base.	Track.	Extreme Length	Road Clearance.	Length of Body. Space.	Dash to Back Wheel Centre	Tyres.
		mm.	c.c.											ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	mm.
*10-12 Star (4) ....England	4	80×120	2409	£230	£305	4	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, D. ...	Fixed ..	8 4	4 3	11 7	8½	6 7½	—	810×90
*12-15 Star (4) .... ,,	4	80×120	2409	£265	£350	5	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	10 0	4 9	14 1	8½	7 9	—	810×100
*15.9 Star (4) .... ,,	4	80×150	3012	£300	£400	5	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	10 3½	4 9	14 4½	8½	7 9	—	815×105
*15.9 Star (4) .... ,,	4	80×150	3012	£310	£490	7	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	10 9½	4 9	14 10½	8½	8 3	—	820×120
*20.1 Star (4) .... ,,	6	90×150	3817	£350	£460	5	Dual	Zenith ..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	10 3½	4 9	14 4½	8½	7 9	—	820×120
*20.1 Star (4) .... ,,	6	90×150	3817	£360	£535	7	Dual	Zenith ..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	10 9½	4 9	14 10½	8½	8 3	—	820×120
* 8-10 Stellite (4) ......England	3	62×89	1075	—	£158	2	Mag.	S.U.	Leather cone	2	Worm	Steel, D.	Fixed ..	8 0	3 10	10 10	6½	—	5 11	800×70
*13.9 Stoewer (4) ......Germany	4	75×88	1556	£250	£310	4	Mag.	G. & A. .	Multiple disc	4	Bevel	R.-W., D. ...	Fixed ..	8 6	4 2	11 9	9	7 2	—	760×90
*15.9 Stoewer (4) ...... ,,	4	80×120	2409	£352	£441	4	Mag.	G. & A. .	Multiple disc	4	Bevel	R.-W., D. ...	Fixed ..	9 10	4 5	13 4	9	8 3	—	820×120
*30 Stoewer (4) .... ,,	8	110×130	4942	£575	£750	4	Mag.	G. & A. .	Multiple disc	4	Bevel	—	—	10 9	4 9	14 10	9	9 2	—	880×120
*48.6 Stoewer (4) ...... ,,	21	140×140	8620	£1000	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
20-30 Storero (4) .....Italy	6	95×130	3680	£380	—	—	Mag.	Zenith ..	Multiple disc	4	Bevel	Wire, D.	Fixed ..	10 0	4 9½	—	6	8 0	7 5	815×105
25-35 Storero (4) ..... ,,	8	100×140	5313	£455	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
*12 Stoneleigh (4) .....England	4	75×114	2015	£275	£350	4	Mag.	Mult. jet	Leather cone	3	Worm	Wire, D.	Fixed ..	9 3	4 8	12. 0	10	7 0	—	810×90
*15-20 Straker-Squire (4) England	6	90×120	3052	£345	£455	2	Mag.	Ware ...	Leather cone	4	Bevel	Wire, D.	Fixed ..	9 6	4 5	13 1	8¼	8 0½	6 9½	810×100
*15-20 Straker-Squire (4) ,,	6	90×120	3052	£345	£500	4	Mag.	Ware ...	Leather cone	4	Bevel	Wire, D.	Fixed ..	9 6	4 5	13 1	8¼	8 0½	6 9½	815×105
*15-20 Straker-S. (4) (lan'let) ..	6	90×120	3052	£345	£580	6	Mag.	Ware ...	Leather cone	4	Worm	Wire, D.	Fixed ..	9 6	4 5	13 1	8¼	8 0½	6 9½	815×105
*15-20 Straker-S. (4) (limou.) ..	6	90×120	3052	£345	£570	6	Mag.	Ware ...	Leather cone	4	Worm	Wire, D.	Fixed ..	9 6	4 5	13 1	8¼	8 0½	6 9½	815×105
*15-20 Straker-S. (4) (sporting)	6	90×120	3052	£410	£550	2	Mag.	Ware ...	Leather cone	4	Bevel	Wire, D.	Fixed ..	9 3	4 5	12 10	8¼	7 9½	6 6½	815×105
*15-20 Straker-S. (4) (sporting)	6	90×120	3052	£410	£565	4	Mag.	Ware ...	Leather cone	4	Fevel	Wire, D.	Fixed ..	9 3	4 5	12 10	8¼	7 9½	6 6½	815×105
*15-20 Studebaker (4) ..U.S.A.	6	90×127	3232	—	£200	4	Mag.	Holley ..	Leather cone	3	Eevel	Wood, F. ...	Booth ..	8 7	4 8½	11 10	10	—	—	760×90
*20-25 Studebaker (4) .. ,,	8	105×127	4399	—	£295	6	Dual	Holley ..	Leather cone	3	Bevel	Wood, F. ...	Booth ..	9 8	4 8½	13 10	10	—	—	875×105
* Studebaker Four (4) ,,	6	90×127	3232	—	£235	5	—	Schebler	Leather cone	3	Bevel	Wood, F. ...	Detach. .	9 0	4 8½	—	—	—	—	810×90
*25-30 Studebaker (6) .. ,,	8	90×127	4848	—	£350	6	Dual	Holley ..	Leather cone	3	Bevel	Wood, F. ...	Booth ..	10 1	4 8½	14 3	10	—	—	875×105
12-16 Sunbeam (4) ....England	4	80×150	3012	£350	£390	5	Mag.	Claudel..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	10 4⅛	4 6	13 11¼	8	8 3¼	7 5½	815×105
*16-20 Sunbeam (4) .... ,,	6	90×160	4070	£460	£535	5	Dual	Claudel..	Leathgr cone	4	Bevel	Wood, D. ...	Fixed ..	10 9⅝	4 7	14 9¾	8	8 5½	7 7½	820×120
*25-30 Sunbeam (6) .... ,,	8	90×160	6105	£585	£670	5	Dual	Claudel..	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	11 8½	4 7	15 0¾	8	8 5½	7 7½	880×120
* 7 Swift (2) ....England	3	75×110	972	-	£140	2	Mag.	—	Leather cone	3	Bevel	Wire, F.	Fixed ..	7 3	3 7	10 1	7½	6 0	5 1	700×80
*11.9 Swift (4) .... ,,	3	69×120	1795	£255	£285	3	Mag.	—	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	9 0	4 3	12 6	9	7 5½	6 6½	760×90
*13.9 Swift (4) .... ,,	4	75×110	1940	£265	£325	4	Mag.	—	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	9 0	4 3	12 10	9	7 5½	6 6½	760×90
*15.9 Swift (4) .... ,,	4	80×130	2610	£345	£385	5	Mag.	—	Leather cone	4	Bevel	Wood, D. ...	Fixed ..	9 9	4 4	14 4	9	7 11	7 1⅛	815×105
*12 Talbot (4) ....England	4	80×120	2409	—	£410	4	Dual	Stewart .	Leather cone	4	Bevel	Steel, D.	Fixed ..	9 4	4 3	13 4	8½	7 8½	5 3½	815×105
*15-20 Talbot (4) (short) ,,	4	80×130	2610	£350	£460	4	Dual	Stewart .	Leather cone	4	Bevel	Steel, D.	Fixed ..	9 4	4 3	13 4	8½	7 8½	5 3½	815×105
15-20 Talbot (4) (long) ,,	4	80×130	2610	£365	—	4	Dual	Stewart .	Leather cone	4	Bevel	Steel, D.	Fixed ..	10 0	4 3	14 0	8½	8 4½	5 11½	815×105
20-30 Talbot (4) ...... ,,	6	90×140	3561	£425	£495	5	Dual	Stewart .	Leather cone	4	Bevel	Steel, D.	Fixed ..	10 7	4 7½	14 7	7½	8 8	6 2½	820×120
25-50 Talbot (4) ...... ,,	10	102×140	4530	£515	£610	5	Dual	Stewart .	Leather cone	4	Bevel	Steel, D.	Fixed ..	10 7	4 7½	14 7	7½	8 8	6 2½	820×120
*20-40 Talbot (6) ...... ,,	6	80×120	3614	£565	£645	5	Dual	Stewart .	Leather cone	4	Bevel	Steel, D.	Fixed ..	11 0	4 7½	14 7	8½	8 8	6 2½	820×120
*14 Turcat-Méry (4) ...France..	4	80×130	2610	£370	—	—	Mag.	Own	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	—	—	—	—	—	—	—
*18 Turcat-Méry (4) ... ,,	6	90×130	3307	£420	—	—	Mag.	Own	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	—	—	—	—	—	—	—
*25 Turcat-Méry (4) ... ,,	6	100×130	4082	£530	—	—	Mag.	Own	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	—	—	—	—	—	—	—
*28 Turcat-Méry (4) ... ,,	6	100×150	4704	£570	—	—	Mag.	Own	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	—	—	—	—	—	—	—
*35 Turcat-Méry (4) ... ,,	8	110×160	6082	£735	—	—	Mag.	Own	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	—	—	—	—	—	—	—

*Price of 10-12 h.p. Star complete car includes hood, screen, five lamps, and spare wheel; prices of other Star models (complete cars) include dynamo lighting set with five lamps and spare wheel. *Stellite price includes lamps, horn, hood, and screen. *Stoewer complete car prices include hood, screen, three lamps, horn, and number-plates; five R.-W. detachable wire wheels are included in the prices of the 13.9 h.p. and 15.9 h.p. models; a Delco engine-starting and lighting set is fitted to the 48.6 h.p. model. *Stoneleigh car has Knight engine; price of two-seater, with dickey, £345. *Straker-Squire chassis prices do not include tyres; complete car prices include spare wheel and tyre, hood, screen, five lamps, speedometer, registration and number-plates; Colonial model, with special gear ratios, springs, radiator, petrol tank, and road wheels, 9¾in. clearance, chassis price with five detachable wire wheels, but without tyres, £356. *Studebaker prices include hood, screen, all lamps, horn, and speedometer; the "Four," the 20-25 h.p. and 25-30 h.p. cars have electric lighting and engine-starting systems; ignition on the Studebaker "Four" is by Remy high tension distributor from dynamo. *Prices of 16-20 h.p. and 25-30 h.p. Sunbeams include a Rotax-Leitner dynamo lighting set. *Swift prices include hood, screen, horn, spare wheel and tyre, and all lamps, the 15·9 model having an electric lighting equipment. *12 h.p. and 15-20 h.p. Talbot (short) prices include hood, screen, horn, and electric lighting set; prices of the six-cylinder model include an electric lighting set. *Turcat-Mery prices do not include tyres.

The Autocars of 1914.—

H.P., Name of Car, Number of Cylinders, and Country of Origin.	Tax in Gns.	Bore and Stroke.	Cubic Capacity.	Price. Chassis with tyres.	Price. Car Complete.	No. of Seats.	Ignition	Carburetter.	Clutch.	No. of Gears	Final Drive.	Wheels.	Rims.	Wheel-base.	Track.	Extreme Length	Road Clearance.	Length of Body Space.	Dash to Back Wheel Centre	Tyres.
		mm.	c.c.											ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	mm.
*10 Turner (4) .... England	3	60×100	1128	—	£220	2 or 3	Mag.	Zenith ..	Leather cone	3	Worm	Wire, F.	Detach.	8 1	4 0	10 9	10	6 6	—	750× 80
*10 Turner (4) .... ,,	3	60×100	1128	—	£250	2 or 3	Mag.	Zenith ..	Leather cone	4	Worm	Wire, F.	Detach.	8 1	4 0	10 9	10½	6 6	—	760× 90
*10 Turner (4) .... ,,	3	60×100	1128	—	£250	4	Mag.	Zenith ..	Leather cone	4	Worm	Wood, D.	Fixed ..	9 0	4 0	12 0	10	6 11	—	760× 90
*12 Turner (4) .... ,,	4	70×120	1821	—	£275	4	Mag.	Zenith ..	Leather cone	4	Worm	Wire, F.	Detach.	8 8	4 0	11 6	10	6 11	—	760× 90
* 6-8 Tweenie (1) ...... France..	2	90×120	763	£110	£134	2	Mag.	Solex ...	—	7	Chain	Wire, F.	Fixed ..	7 6	3 10	10 0	7	—	—	650× 65
* 8-10 Tweenie (2) ..... ,,	2	72×120	976	—	—	2	Mag.	Solex ...	—	7	Chain	Wire, F.	Fixed ..	7 0	3 6	9 0	7	—	—	650× 65
*10-12 Tweenie (4) ..... ,,	3	65×110	1460	£145	£185	2	Mag.	Solex ...	—	7	Chain	Wire, F.	Fixed ..	7 9	3 10	10 8	7	—	—	700× 85
12-18 Unic (4) .... France..	4	80×130	2610	£330	—		Mag.	Own	Leather cone	4	Bevel	Wood, F. ...	Captain	10 0¼	4 4	13 10	7	8 0⅛	7 2	815×105
16-24 Unic (4) .... ,,	6	90×130	3307	£368	—	—	M. Acc.	Own	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 6	4 7½	15 3	7	8 0⅛	7 3	815×105
24-30 Unic (4) .... ,,	6	102×150	4903	£550	—		M. Acc.	Own	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	12 1	4 9	16 2¾	7	9 2	8 0	920×120
19-30 Unic (6) .... ,,	6	80×150	4518	£567	—		M. Acc.	Own	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	12 1	4 9	16 2¾	7	8 8	—	920×120
*10 Universal (4) ...... England	3	60×100	1128	—	£250	2	Mag.	Zenith ..	Leather cone	4	Worm	Wood, D. ...	Fixed ..	8 6	4 0	10 10	9	6 6	5 6	700× 85
*15 Valveless (2) ...... England	4	113×127	2547	£315	£430	5	Mag.	Own	Leather cone	4	Worm	Wood, F. ...	S. and C.	10 1	4 8	13 10	10½	8 6	7 8	815×105
*19.9 Valveless (2) ..... ,,	6	127×140	3546	£335	£450	5	Mag.	Own	Leather cone	4	Worm	Wood, F. ...	S. and C.	10 1	4 8	13 10	10½	8 6	7 8	815×105
*16-20 Vauxhall (4) .... England	6	90×120	3052	£375	£465	5	Mag.	—	Multiple disc	4	Bevel	Wood, D. ...	Fixed ..	9 9	4 6	13 3	8	7 9	6 11	815×105
*25 Vauxhall (4) .... ,,	6	95×140	3964	£480	£575	5	Mag.	—	Multiple disc	4	Bevel	Wood, D. ...	Fixed ..	10 10	4 8	14 1	8	8 8	7 9¼	880×120
*25 Vauxhall (4) (P. Henry) ,,	6	95×140	3964	£515	£615	4	Mag.	—	Multiple disc	4	Bevel	Wire, D.	Fixed ..	10 0	4 6	13 6	8	7 9	6 11	875×105
*35 Vauxhall (6) .... ,,	10	95×120	5103	£650	£770	5	Mag.	—	Multiple disc	4	Bevel	Wood, D. ...	Fixed ..	11 8	4 8	15 2	9	8 8¼	7 9¼	895×135
10-12 Vermorel (4) .... France..	3	66×110	1505	£225	£275	4	Mag.	Zenith ..	Leather cone	4	Bevel	Wire, F.	Fixed ..	8 6	4 0	11 3	9	7 2	6 5	750× 85
*12-16 Vermorel (4) .... ,,	4	74×120	2064	£275	£325	4	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Michelin	9 4	4 3	12 7	9	8 1	7 0	810× 90
*15-18 Vermorel (4) .... ,,	4	75×130	2298	£312	£385	4	Mag.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Michelin	9 6	4 3	13 4	9	8 3	7 1	815×105
*12.1 Vinot (4) .... France..	4	70×110	1689	£260	£295	2	Mag.	Own	Leather cone	3	Bevel	Wood, F. ...	Captain	9 2	4 0	12 8	9½	7 8	6 10	760× 90
*12.1 Vinot (4) .... ,,	4	70×110	1689	£285	£335	4	Mag.	Own	Leather cone	4	Bevel	Dunlop, D. ..	Fixed ..	9 2	4 0	12 8	9½	7 8	6 10	760× 90
*15.9 Vinot (4) .... ,,	4	80×110	2208	£300	£415	4	Mag.	Own	Leather cone	3	Bevel	Wood, F. ...	Captain	9 3	4 1	13 0	9½	7 8½	6 8½	810× 90
*15-20 Vinot (4) (landaulet) ,,	4	80×130	2610	£345	£465	4	Mag.	Own	Leather cone	4	Bevel	Dunlop, D. ..	Fixed ..	9 9	4 5	13 6	9½	8 0½	7 0½	815×105
*15-20 Vinot (4) (landaulet) ,,	4	80×130	2610	£360	£560	6	Mag.	Own	Leather cone	4	Bevel	Dunlop, D. ..	Fixed ..	9 9	4 5	13 6	9½	8 0½	7 0½	820×120
*25-30 Vinot (4) (landaulet) ,,	6	101×130	4166	£500	£745	6	Mag.	Own	Leather cone	4	Bevel	Dunlop, D. ..	Fixed ..	11 0	4 6	14 9	9½	8 10	7 6	835×135
12-15 Vivinus (4) ..... Belgium	4	75×110	1940	£275	£325	4	Mag.	—	—	3	Bevel	—	—	9 6	4 3	—	9	—	—	810× 90
16-20 Vivinus (4) ..... ,,	6	90×110	2798	£325	£375	4	Mag.	—	—	3	Bevel	—	—	9 6	4 5	—	9¾	—	—	815×105
20-30 Vivinus (4) ..... ,,	8	106×120	4224	£425	£500	4	Mag.	—	—	3	Bevel	—	—	10 0	4 5	—	9¾	—	—	815×105
*10-15 Vulcan (4) ...... England	4	80×120	2409	£235	£265	2	Mag.	Long'mre	Leather cone	3	Worm	Wood, D. ...	Fixed ..	9 0	4 1	12 8	8½	7 6	6 9	760× 90
*10-15 Vulcan (4) ...... ,,	4	80×120	2409	£235	£295	4	Mag.	Long'mre	Leather cone	3	Worm	Wood, D. ...	Fixed ..	9 0	4 1	12 8	8½	7 6	6 9	760× 90
*15.9 Vulcan (4) .... ,,	4	80×130	2610	£285	£325	2	Mag.	Long'mre	Leather cone	4	Worm	Wood, D. ...	Fixed ..	9 5½	4 8	13 1	8½	8 0	7 2	815×105
*15.9 Vulcan (4) .... ,,	4	80×130	2610	£285	£350	5	Mag.	Long'mre	Leather cone	4	Worm	Wood, D. ...	Fixed ..	9 5½	4 8	13 1	8½	8 0	7 2	815×105
*15-20 Vulcan (4) ...... ,,	4	80×150	3012	£325	£375	2	Mag.	Long'mre	Leather cone	4	Worm	Wood, D. ...	Fixed ..	10 2	4 8	13 4	8½	8 0	7 2	820×120
*15-20 Vulcan (4) ...... ,,	4	80×150	3012	£325	£400	5	Mag.	Long'mre	Leather cone	4	Worm	Wood, D. ...	Fixed ..	10 2	4 8	13 4	8½	8 0	7 2	820×120
25-30 Vulcan (6) ...... ,,	8	89×120	4476	£425	£505	5	Dual	Polyrhoe	Leather cone	4	Worm	Wood, D. ...	Fixed ..	10 3	4 8	14 0	8½	7 3	8 2	875×105
25-30 Vulcan (6) (landaulet)	8	89×120	4476	£455	£675	—	Dual	Polyrhoe	Leather cone	4	Worm	Wood, D. ...	Fixed ..	—	4 8	—	8½	—	—	880×120
*10-12 Waverley (4) ... England	3	65×130	1728	£215	£235	2	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, D. ...	Fixed ..	9 2	4 4	12 4	9½	6 2	5 9	750× 85
*12-15 Waverley (4) ... ,,	4	70×120	1843	£230	£285	2	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, D. ...	Fixed ..	9 2	4 4	12 4	9½	6 2	5 9	760× 90
*12-15 Waverley (4) (Col.) ,,	4	70×120	1843	£240	£295	2 to 4	Mag.	Zenith ..	Leather cone	3	Bevel	Steel, D.	Fixed ..	9 2	4 4	12 4	10½	6 2	5 9	810× 90

*Turner prices include hood, screen, and five lamps; Shrewsbury and Challiner or Warland detachable rims are fitted to the three models fitted with fixed wire wheels. *Tweenie cars are friction driven; prices include hood, screen, lamps, and horn. *Universal price includes all-weather coupé body, dynamo lighting set with five lamps, five detachable wheels, etc.; wire wheels with Shrewsbury and Challiner detachable rims can be fitted at the same price. *Both Valveless models have two-stroke engines; complete prices include hood with side curtains, screen, horn, number-plates, three lamps, and spare Shrewsbury and Challiner rim. *Vauxhalls have Bosch hand-operated engine-starting magnetos; the price of the 16-20 h.p. model (car complete) includes hood, screen, lamps, and horn. *12-16 h.p. and 15-18 h.p. Vermorel Colonial models have 11in. clearance. *Vinot complete car prices include hood, screen, dickey on two-seaters, five lamps, horn, and spare wheel or rim. *Complete car prices of the Vulcan four-cylinder models include hood, screen, three lamps, and horn. *Waverley complete car prices include hood, screen, five lamps, speedometer, spare wheel and tyre.

The Autocars of 1914.—

H.P., Name of Car, Number of Cylinders, and Country of Origin.	Tax in Gns.	Bore and Stroke.	Cubic Capacity.	Price. Chassis with tyres.	Price. Car Complete.	No. of Seats.	Ignition	Carburetter.	Clutch.	No. of Gears	Final Drive.	Wheels.	Rims.	Wheel-base.	Track.	Extreme Length	Road Clearance.	Length of Body Space.	Dash to Back Wheel Centre	Tyres.
		mm.	c.c.											ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	mm.
*12-15 Waverley (4) ... England	4	75×120	2116	£230	£285	2 or 3	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, D. ...	Fixed ..	9 2	4 4	12 4	9½	6 2	5 9	760×90
*12-15 Waverley (4) (long) ,,	4	75×120	2116	£235	—	4	Mag.	Zenith ..	Leather cone	3	Bevel	Wood, D. ...	Fixed ..	9 7	4 4	12 9	9½	6 7	6 2	760×90
20-30 White (4) (short) U.S.A.	6	95×130	3680	£408	—	5	Mag.	Own	Leather cone	4	Bevel	Wood, F. ...	Warland	9 2	4 8	12 0	10	7 4	6 8	820×120
20-30 White (4) (long) . ,,	6	95×130	3680	£478	—	7	Mag.	Own	Leather cone	4	Bevel	Wood, F. ...	Warland	10 0	4 8	14 0	10	8 4	7 8	880×120
*10 Wilton (4) .... England	3	59×100	1094		£185	2	Mag.	—	Multiple disc	3	Bevel	Sankey, D. ..	Fixed	9 0	4 0	11 4	8	—	—	750×80
8 Winco (2) .... England	3	88×92	1119	£137	£150	2	Mag.	Zenith ..	Leather cone	3	Bevel	Wire, F.	Fixed ..	9 6	4 0	12 3	10	6 1	6 3	750×85
10-12 Windhoff (4) .... Germany	4	70×100	1539	£250	£290	4	Mag.	Marvel ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 5	4 2	—	—	—	—	760×90
12-14 Windhoff (4) .... ,,	4	70×118	1816	£275	£320	4	Mag.	Marvel ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 5	4 2	—	—	—	—	760×90
14-16 Windhoff (4) .... ,,	4	75×118	2080	£300	£345	4	Mag.	Marvel ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	9 5	4 2	—	—	—	—	810×100
16-20 Windhoff (4) .... ,,	4	80×130	2610	£400	£470	4	Dual	Marvel ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 3	4 2	—	—	—	—	815×105
30-40 Windhoff (4) .... ,,	6	95×155	4395	£600	£675	4	Dual	Marvel ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 3	4 2	—	—	—	—	895×135
20-30 Windhoff (6) .... ,,	6	80×130	3915	£550	£625	4	Dual	Marvel ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	10 7	4 2	—	—	—	—	820×120
15.9 Wingfield (4) ..... England	4	80×130	2610	£320	—	4	Mag.	—	Multiple disc	4	Bevel	Sankey, D. ..	Fixed ..	9 6	4 6	12 0	—	—	—	815×105
*20 Withers (4) .... England	6	90×130	3307	£430	£630	6	Dual	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Vinet ...	9 6	4 7	—	—	8 2	6 9	815×105
*25 Withers (4) .... ,,	6	100×130	4082	£500	£740	6	Dual	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Vinet ...	10 3	4 7	—	—	8 2	7 0	880×120
*30 Withers (4) .... ,,	8	110×130	4942	£560	£830	6	M. Acc.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Vinet ...	10 8	4 7	—	—	8 6	7 3¼	880×120
*35-40 Withers (4) ..... ,,	10	120×130	5876	£600	£880	6	M. Acc.	Zenith ..	Leather cone	4	Bevel	Wood, F. ...	Vinet ...	10 8	4 7	—	—	8 6	7 3¼	895×135
*16-20 Wolseley (4) (short) Eng.	6	90×121	3080	-	£475	5	Mag.	S.U.	Mult. plate .	4	—	Wire, D.	Fixed ..	10 4	4 5	13 10	6½	8 8	7 5	815×105
*16-20 Wolseley (4) (long) ,,	6	90×121	3080		£620	6	Mag.	S.U.	Mult. plate .	4		Wire, D.	Fixed ..	10 10	4 5	14 5	6½	9 2	7 11	820×120
*24-30 Wolseley (6) (short) ,,	8	90×130	4961		£695	5	Mag.	Own	Mult. plate ..	4	—	Wire, D.	Fixed ..	10 11	4 7	15 3	8½	8 11	7 6	895×135
*24-30 Wolseley (6) (long) ,,	8	90×130	4961	...	£825	6	Mag.	Own	Mult. plate ..	4	—	Wire, D.	Fixed ..	11 5	4 7	15 9	8½	9 5	8 0	895×135
*30-40 Wolseley (6) (short) ,,	10	102×140	6864	—	£945	5	Dual	Own	Mult. plate .	3	—	Wire, D.	Fixed ..	11 7	4 7	16 0	8½	8 11	7 6	895×135
*30-40 Wolseley (6) (long) ,,	10	102×140	6864	—	£1075	6	Dual	Own	Mult. plate .	3	—	Wire, D.	Fixed ..	12 1	4 7	16 6	8½	9 5	8 0	895×135
8 Woodrow (2) (water-c'd) Eng.	3	85×85	964	£125	£140	2	Mag.	E.I.C. Cox	Leather cone	3	Worm	Sankey, D. ..	Fixed ..	7 0	4 0	10 10	9½	5 10	5 2¼	650×65
10 Woodrow (2) (air-cooled) ,,	3	85×96	1090	£111	£126	2	Mag.	E.I.C. Cox	Leather cone	3	Worm	Sankey, D. ..	Fixed ..	7 0	4 0	10 10	9½	5 10	5 2¼	650×65
10-15 Y.A.X.A. (4) Switzerland	3	67×120	1693	£225	—	—	Mag.	Claudel ..	Leather cone	4	Bevel	Wood, F. ...	Fixed ..	8 6	4 2	12 2	10	7 3	6 9	760×90
6 Zebra (1) .... France	2	88×106	645	—	£150	2	Mag.	Own	Disc	3	Bevel	Wood, F. ...	Fixed ..	6 0	3 6	—	—	—	—	700×75
8 Zebra (4) .... ,,	2	50×100	785		£175	2	Mag.	—	Disc	3	Bevel	Wood, F. ...	Fixed ..	6 8	3 10	—	—	—	—	700×75
14-20 Zedel (4) .... France..	4	72×120	1953	£290	—	—	Mag.	Own	Disc	4	Bevel	Wood, F. ...	Fixed ..	8 2	3 11	12 0	9	7 2	6 1	765×105
18-22 Zedel (4) .... ,,	4	75×130	2298	£325	-		Mag.	Own	Disc	4	Bevel	Wood, F. ...	Fixed ..	9 2	4 1	13 0	10	7 6½	6 6	765×105
25-30 Zedel (4)	6	90×140	3561	£450	- -		Mag.	Own	Disc	4	Bevel	Steel, D.	Fixed ..	10 0	4 3½	14 3	11	8 6	7 3½	820×105

*The 12-15 h.p. 75 × 120 Waverley has splash lubrication; complete car prices include hood, screen, five lamps, speedometer, spare wheel, and tyre. *Wilton price includes hood and screen.
*Withers complete car prices are for limousine-landaulet bodies; the Claudel carburetter can be fitted to all chassis. * All six-cylinder Wolseley cars are fitted with a compressed air self-starter.

Steam Cars.

H.P., Name of Car, Number of Cylinders, and Country of Origin.	Tax in Gns.	Bore and Stroke.	Price. Chassis with tyres.	Price. Car Complete.	No. of Seats.	No. of Gears.	Final Drive.	Wheels.	Rims.	Wheel-base.	Track.	Extreme Length.	Road Clearance.	Length of Body. Space.	Dash to Back Wheel Centre.	Tyres.
		mm.								ft. in.	ft. in.	ft. in.	in.	ft. in.	ft. in.	mm.
*18 Pearson-Cox (3) .... England	2	45×64	£155	£185	2 or 3	—	Chain ..	Wire, F.	Fixed	7 0	3 9	9 0	7½	5 10	5 3	700×65
15 Pearson-Cox (3) .... ,,	3	61×77	£330	£380	2	—	Bevel ..	Wood, F.	Fixed	9 0	4 2	12 0	8	7 9	6 6	810×90
15 Pearson-Cox (3) .... ,,	3	61×77	£330	£485	5	—	Bevel ..	Wood, F.	Fixed	9 0	4 2	12 0	8	7 9	6 6	815×105
*10 Stanley (2) .... U.S.A.	3	82×108	£230	£250	2	1	Spur ..	Wood, F.	Fixed	8 9	4 6	12 0	8	6 8	6 5	760×90
*20 Stanley (2) .... ,,	3	82×108		£320	4	1	Spur ..	Wood, F.	Fixed	8 9	4 6	12 0	8	6 8	6 5	760×90
*20 Stanley (2) .... ,,	6	102×127	£340	£395	2	1	Spur ..	Wood, F.	Fixed	9 8	4 6	13 0	10	7 7	7 2	915×105
*20 Stanley (2) .... ,,	6	102×127	—	£435	5	1	Spur ..	Wood, F.	Fixed	9 8	4 6	13 0	10	7 8	7 1	815×105

* Price of 8 h.p. Pearson-Cox complete includes lamps. * Stanley complete car prices include hood, screen, and five lamps.

Freight Charges and Duties on Motor Cars Shipped Abroad.

THE freight charges include cost of cartage in London within four miles of the Bank, packing, dock dues, shipping, and freight per 40 cubic feet (unless otherwise stated). When the weight of the car or chassis packed exceeds 30 cwt., the charge is more. Figures given are for one car or chassis only.

For the compilation of the following tables we are indebted to an old established firm of carriers and shippers, Messrs. Davies, Turner, and Co., Ltd., of 52, Lime Street, London, E.C.,

Name of Country to which the Rates and Duties apply.	Cost of Cartage in London within 4 mls of the Bank, packing in Case, Dock Dues, Shipping & Freight per 40 cubic ft. (unless otherwise stated) £	s.	d.	These Duties are compiled from Official Sources, but without Responsibility. % = per centum *ad valorem*.
ANTIGUA				
St. John's	3	3	6	10⅔% under the Preferential Tariff 13⅓% under General Tariff
ARGENTINE REPUBLIC				
Buenos Ayres	2	17	0	12%*
AUSTRALIA				
Adelaide	3	0	3	Bodies, including dashboards, footboards, and mudguards, if of British manufacture: single-seated, £15; double seated, £21; with fixed or movable canopy tops, *e.g.*, landaulet, limousine, taxicab, or similar types, and n.e.i. £36; chassis (British), free; chassis (if of foreign manufacture), 5%. pneumatic tyres (including covers and tubes), 1s. 2d. per lb., or 20%.
Brisbane	3	0	3	
Melbourne	3	0	3	
Sydney	3	0	3	
Fremantle	3	5	0	
Hobart	3	5	0	
Launceston	3	5	0	
AUSTRIA-HUNGARY				
Trieste	1	18	6	Over 400 kilos. and up to 1,800 kilos. per cwt. £2 10 10 1,800 ,, 3,200 ,, £2 2 4 3,200 ,, £1 5 5
BAHAMAS				
Nassau	4	4	0	10%
BARBADOES				
Bridgetown	2	16	0	9 % under the Preferential Tariff 11¼% under the General Tariff
BELGIUM				
Antwerp	5	14	3 20ct	12%
Ostend	6	0	0 ,,	
Brussels	10	3	0 car	
BRAZIL				
Bahia	4	6	9	7%*
Rio de Janeiro	3	12	3	
Santos	3	10	3	
BULGARIA				
Sofia	4	5	9	£10 each.
CANADA				
Halifax, N.S. (summer season)	2	7	0	Under British Pref. Tariff 22½% ,, Intermediate Tariff, 30% ,, General Tariff, 35%
Montreal (summer season)	2	10	0	
Quebec (summer season)	2	12	9	
St. John's, N.B. (summer season)	2	7	0	
Vancouver, B.C. (summer season)	18	1	0 20ct.	
Victoria, B.C.	18	1	0 ,,	
CEYLON				
Colombo	2	0	9	5½%
CHINA				
Hong-Kong	2	15	6	Free
Shanghai	2	18	0	5%
CYPRUS				
Larnaca	2	15	0	10%
DENMARK				
Copenhagen	1	9	9	5s. 7½d. per cwt.
DOMINICA				
Roseau	3	4	9	10% under the Preferential Tariff 12½% under the General Tariff
EGYPT				
Alexandria	2	4	6	8%
Port Said	1	17	9	
FIJI				
Suva	4	4	3	12½%
FINLAND (summer season)				
Helsingfors	1	16	6	"Carriages with wheels with springs": Wholly covered, £12; half covered, £6; not covered (open), £2 8s.
Hango	1	16	6	
FRANCE				
Bordeaux	13	3	0 car	From 500 to 2,500 kilos. (exclusive), £1 10s. 6d. per cwt.; 2,500 kilos. or more, £1 0s. 4d. per cwt.
Boulogne	5	5	0 20ct.	
Marseilles (per 40 ft.)	1	16	6	
Paris	8	5	0 20ct.	
GERMANY				
Bremen	11	7	0 car	Over 500 and up to 1,000 kilos., 12s. 6d. per cwt.; over 1,000 kilos., 7s. 6d. per cwt.
Hamburg	6	9	0 20ct.	
GOLD COAST				
Accra and Cape Coast	3	12	6	Free
GREECE				
Piræus	2	3	3	From £20 to £130 per car, according to the h.p. and number of cylinders (particulars on application).
GRENADA				
St. Georges	3	1	6	10%
GUIANA (British)				
Demerara	2	15	6	12% under Preferential Tariff, 15% under General Tariff (plus 10% of the amount of duty leviable at the rate given).
HAWAII				
Honolulu	18	11	9 20cwt.	45%*
HAYTI	4	17	3	On application*
HOLLAND				
Amsterdam	6	8	6 20ct.	5%
Rotterdam	6	9	6 ,,	
HONDURAS (British)				
Belize	3	11	0	12½%
ITALY				
Genoa	9	5	6 20ct.	Over 500 kilos. and up to 1,000 kilos., £16 each; more than 1,000 kilos., £24 each
Leghorn	10	5	6 ,,	
Naples	10	5	6 ,,	

Name of Country to which the Rates and Duties apply.	Cost of Cartage in London within 4 mls of the Bank, packing in Case, Dock Dues, Shipping & Freight per 40 cubic ft. (unless otherwise stated) £	s.	d.	These Duties are compiled from Official Sources, but without Responsibility. % = per centum *ad valorem*.
INDIA				
Bombay and Karachi	1	15	6	5%
Calcutta	1	15	6	
Madras	2	0	3	
JAMAICA				
Kingston	2	17	6	10%
JAPAN				
Kobe	2	18	0	50% according to the General Tariff; 35% according to the Conventional Tariff, which necessitates a certificate of origin
Yokohama	2	18	0	
LIBERIA				
Monrovia	4	4	0	12½%*
MAURITIUS				
Port Louis	2	19	6	12%
MEXICO				
Vera Cruz	2	19	9	More than 750 kilos.: For the first 250 kilos. £3 8s. 6d. per cwt.; for the following 500 kilos, £2 17s. 1d. per cwt.; for the weight in excess of 750 kilos., £2 6s. 8d. per cwt.*
MONACO				
Nice (for Monte Carlo)	2	8	6	Same as France
MONTSERRAT				
Plymouth	3	6	0	10⅔% under the Preferential Tariff 13⅓% under the General Tariff
MOROCCO				
Tangier	2	2	6	12½%
NEVIS				
Charlestown	3	6	0	8⅘% under the Preferential Tariff 11% under the General Tariff
NEWFOUNDLAND				
St. John's	2	4	0	30%
NEW ZEALAND				
Auckland	3	5	0	Motor car bodies and mudguards, 20%; chassis for motor cars (whether attached or unattached), including wheels, speed gears, and radiators, free
Wellington	3	5	0	
Dunedin	3	7	6	
Lyttleton	3	7	6	
NICARAGUA				
Corinto	3	11	0	$15 (gold) per 100 kilos.*
NIGERIA				
Lagos	3	7	6	Free
NORWAY				
Christiania	1	9	9	12%
PERU				
Callao	3	15	3	5%*
PORTUGAL				
Lisbon	1	15	9	£27 each*
ROUMANIA				
Bucharest	2	19	6	From 500 to 1,000 kilos., 18s. 3d. per cwt.; 1,000 kilos. or more, 12s. 2½d. per cwt
RUSSIA (summer season)				
St. Petersburg	1	9	9	Cars with 4 places or more, £23 4s. 5d. each; with less than 4 places, £14 15s. 7d
ST. LUCIA				
Castries	3	3	9	12% under the Preferential Tariff 15% under the General Tariff
ST. VINCENT				
Kingstown	3	3	9	8% under the Preferential Tariff 10% under the General Tariff
SIAM				
Bangkok	2	15	6	3%
SIERRA LEONE				
Freetown	3	7	6	10%
SOUTH AFRICA				
Capetown	3	5	0	Under British Pref. Tariff, 12% ,, General Tariff, 15%
Port Elizabeth	3	5	0	
Delagoa Bay	3	18	0	
East London	3	11	3	
Durban (Natal)	3	12	6	
SPAIN				
Barcelona	1	19	0	Not more than 1,000 kilos., £1 12s. 6d. per cwt.; more than 1,000 kilos., £2 0s. 8d. per cwt. plus £8 if open carriage, or £12 16s. if closed carriage.*
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Penang and Singapore	2	10	9	Free
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TOBAGO	3	1	6	£8 each under the Preferential Tariff £10 each under the General Tariff
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Constantinople	2	3	3	11%
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Boston	2	6	9	45% if valued at $2000 or more* 30% if valued at less than $2000*
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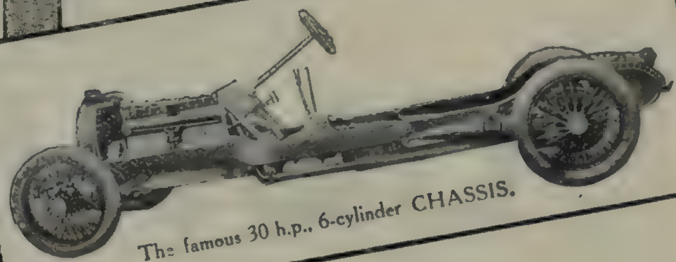

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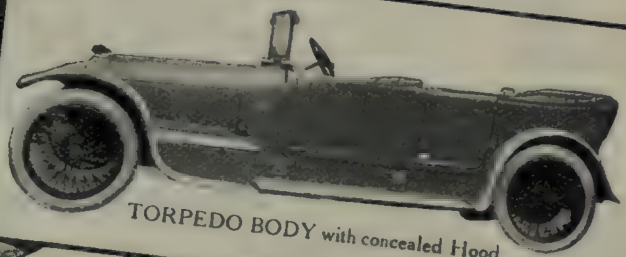

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Electric Car Lighting Systems

An Alphabetically Arranged Description of the Principal Systems on the Market

FEW developments in connection with the motor industry have been more prominent during the last two or three years than the progress and popularity which have been made in electric lighting systems. Almost unheard of a few years ago, electric car lighting dynamos have almost completely ousted all other forms of illuminant, and there can be no doubt that they represent the standard equipment of the immediate and distant future. The difficulties which stood in the way of the successful application of electric lighting to motor cars have one and all been gradually surmounted by the employment of various ingenious devices, the most notable of which will be found described in this article.

The striking feature of the average electric lighting set is its intense reliability, and it is rather notable that in no case has the inclusion of special current regulating devices had any harmful effect whatever upon the consistent output of the electric dynamo, which is rightly regarded as one of the most dependable mechanisms produced.

We do not in the present article deal with the lamps or other accessories to the electric lighting systems in common use, as these are mostly of a standard type and have few individualities. It may be mentioned in passing, however, that the electric head lamp has considerable physical advantages over any other type.

First of all, by reason of the fact that as it employs a light metal reflector instead of a heavy glass one, weight is reduced to a minimum. Secondly, the simple cable connections and the removal of all ventilating devices make the shape of the lamp exceedingly neat and, therefore, easy to clean, as the projections are practically confined to two hinges and the lugs by which the lamp is attached to the brackets. Thirdly, the absence of any fumes or high degree of heat renders it possible to keep the reflector in an efficient state almost indefinitely, as the whole body of the lamp is practically sealed up and dust and dirt are therefore excluded.

Functions of the Dynamo.

Turning now to the dynamo, which is, of course, the most important component of the installation, it is obvious that as the engine of a car has to run at varying speeds of from, say, 150 to 3,000 r.p.m., the employment of an ordinary commercial type of dynamo is out of the question, as this form of generator gives an output of electricity more or less directly proportional to the speed at which it is driven. What is required is some method of control by means of which the generator can be made to produce a given amount of current between any desired limits of speed, so that above a given number of r.p.m., the dynamo may be continually charging the battery at a pre-determined rate. It is, of course, essential to employ an accumulator battery in connection with a dynamo lighting outfit, inasmuch as the lamps are frequently required when the engine is not running. Otherwise, many of the dynamos, of which descriptions are given in this article, are so automatic and constant in regulation that they could be relied upon to provide a perfectly steady direct current to the lamps.

There are two principal methods by which automatic control of current output is obtained. The first is mechanical and the second electrical; the latter is, however, more generally favoured than the former, though, in point of actual practice, both have shown themselves perfectly satisfactory. The mechanical principle generally employs some form of centrifugal governor, which operates a clutch that has the effect of breaking the driving connection between the armature and its pulley as soon as the former attains a certain speed.

The result of this arrangement is, of course, that the moment the desired speed is attained, the armature revolves perfectly steadily, no matter how much further the engine speed may be increased. Various forms of electrical device are, as may be seen from the accompanying descriptions, in common use. Many of these depend upon the distortion of the magnetic flux, which takes place when the armature is driven at very high speeds. In other cases, permanent magnets are used, when a somewhat similar effect is obtained. In other machines, compound magnets, that is to say, permanent fields, with electro magnetic subsidiary fields to regulate them, are employed, whilst in still another group a series of regulating coils are employed and serve to control the amount of current which is delivered from the armature to the field magnets.

The Switch or Minimum Cut-out.

When the dynamo is revolving at a speed, below which it gives a current insufficient to charge the battery, it is obvious that unless a form of switch is employed, the battery will tend to discharge through the dynamo and drive it as a motor. For this purpose, what is called a "minimum cut-out" is generally provided, though in some cases a free wheel is mounted on the armature spindle, so as to let the armature in these circumstances revolve comparatively freely. The noise which the ratchet and pawl of the free wheel sets up warns the driver that current is being wasted and he can then switch off. The usual plan is, however, to incorporate an electro-magnetic switch of an automatic type, either working direct from the dynamo or being of a differential kind, so as to act in accordance with the exact state of charge of the battery. Careful designs have rendered these minimum cut-outs almost entirely free from trouble. In some cases the switch, instead of being worked electro-magnetically, is operated by a mechanical contrivance on the centrifugal principle. In practice, both types show themselves equally efficient.

The Transmission Question.

There are various ways of driving electric lighting dynamos, to receive which the engines on but few cars have been specially designed. In the near future, no doubt, it will be the rule to find proper pro-

Electric Car Lighting Systems.

vision made for their installation on all cars, but at present the dynamos simply have to be fixed where it is most convenient. The most usual place is by the side of the clutchshaft, from which they are driven by a V leather chain link or other type of leather belt. They are also found behind the gear box and driven from the propeller-shaft, but this is not so good a position as that already mentioned, as when the car is standing still it is not possible to keep the dynamo in operation.

From this point of view it will readily be perceived that driven direct from the engine is the best way that the dynamo could be driven, as it will then yield current irrespective of the gears being in the neutral position, and whether the car is standing still or not. Unfortunately, other considerations have to be borne in mind, namely, that especially on self-regulating dynamos the carcase of the machine is liable to get very hot, and, therefore, it is not advisable to place them in a position where the heat is increased by that of the engine.

Possibly the best arrangement of all is to have the dynamo driven in tandem with the magneto, and for this purpose some machines are made with the centre of the armature spindle at the correct height from the base-plate. Generally speaking, however, most dynamos are not suitable for this form of drive, as on four-cylinder engines they would by this arrangement only run at crankshaft speed, and this is scarcely fast enough to give natural output with the ordinary form of winding. Where there is sufficient room in front of the engine, the drive can often be arranged to take effect on a second pulley mounted on the fan spindle, the power being thus transmitted to the dynamo through two belts, or by using one belt arranged in triangular form passing from pulley on crankshaft to fan pulley, thence to dynamo pulley and back to the crankshaft.

The Bleriot Dynamo.

There are two entirely different types of Blériot generator. The largest of these gives an output from 150 to 350 watts at 8, 12, and 16 volts, and consists of a simple bi-polar machine in which the automatic regulation of the current generated is effected by means of special windings, so that no mechanical method is employed to give a constant voltage. The whole machine is well enclosed against dust and dirt as shown. There is only one pair of brush holders, each of which is fitted with two carbon brushes. The dynamo is arranged to be driven, either by a V-belt from the engine-shaft or by a friction pulley off the flywheel.

Large Bleriot dynamo.

This type of dynamo is claimed to be one of the most efficient made, and is well capable of sustaining the load of the most elaborate illuminating system. The smaller size Blériot is of the slow speed type, and is fitted with four poles, though only having one pair of carbon brushes. This dynamo cuts in at about 500 r.p.m., and generates its full output at 1,250 r.p.m. Above this the armature is prevented from being driven by means of an automatically slipping clutch, which is carried on the armature shaft, and is attached to the pulley for the driving belt. This clutch is worked by a very simple and well-balanced centrifugal governor, the construction of which is very simple. Normally, the fibre linings of the clutch shoes are held in contact with the inner periphery of a cup-shaped extension of the belt pulley by means of springs, the tension of which is overcome by the centrifugal force acting upon the bob weights when a certain speed is exceeded.

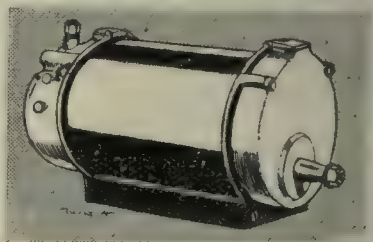
Two types of switchboard are made, one of which (intended for the smaller dynamo) is fitted with a single rotary controller, which effects the charging connection and those of all the lamps. A volt meter and an ammeter, both in permanent connection, are enclosed under a glass window in the sloping top of the case, whilst the position of the rotary switch is made clear through a smaller window. The voltage of the battery can be ascertained by pressing a small ebony push-button. A pin plug adapter is also fitted.

The larger switchboard is also made in cast aluminium, and is of a somewhat similar type, except that three tumbler switches are employed to control the lamp and charging circuit.

Blériot, Ltd., Blériot House, Long Acre, London, W.C.

The Bosch Dyamo.

The Bosch is designed to give electrically the maximum efficiency—in point of fact, it is claimed to have a greater output of energy for its size and weight than any other generator. It is of the simple shunt-wound type, and free from all speed regulating devices, the maintenance of a constant output being dependent upon a second component. This takes the form of an electro-magnetically operated regulator, which controls the amount of electrical energy passing through the field magnets of the dynamo, so that when the speed of the generator increases and the voltage would in the ordinary way increase accordingly, the regulator is automatically brought into operation, reducing the strength of the magnetic field and so preventing the voltage from rising.



Bosch dynamo.

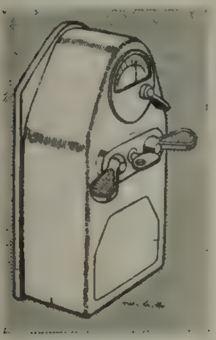
On the other hand, normally when the speed is reduced, the voltage would fall, but here again the regulator comes into action, strengthening the magnetic field in the dynamo and immediately preventing the fall in the terminal voltage. In addition to the voltage regulator, the switchboard contains an electromagnetically operated switch which is automatic in action and prevents any current reaching the battery until the voltage generated by the dynamo is sufficiently high. It further has the secondary function of automatically disconnecting the generator from the battery when the latter is fully charged, thus preventing the possibility of the battery being damaged by overcharging.

Our illustration shows the neat form of the Bosch lighting dynamo which is completely enclosed, and has its armature spindle set at a suitable height for driving it in tandem with the magneto or water pump. The generator is adapted to be held down to its base plate by a quickly detachable metal strap. Special elastic couplings are made for positive drives, either by shaft, chain, or gear. The dynamo is also equipped

to be driven by means of a flat belt, for the tensioning of which a jockey pulley is fitted on the dynamo itself.

The dynamo is rated at 100 watts, and it is possible to draw from it continually a current of 7.5 ampères at 13.5 volts without it becoming unduly heated, though it is possible to obtain a very much greater output than this, as, for instance, when it is necessary to light the lamps as well as to charge an exhausted battery.

The switchboard is a very nice piece of work, and is entirely enclosed in a metal case. There are two main switches, one of which controls the lamps, whilst the other relates to the charging circuit. The latter gives four positions. The first represents all "disconnected," the second the battery alone lighting the lamps, the third the dynamo lighting the lamps direct, and the fourth the dynamo lighting the lamps *viâ* the battery. Above the switches, which can be locked in the "off" position, is a combined voltage and ampère meter, controlled by a third switch lever, as shown. This gives the rate of both charge and discharge of the dynamo and of the battery. The fuses are easily got at, and all the connections are made underneath the board with special unions. The automatic voltage regulator contained in the board is so arranged that it keeps the voltage constant at 13¾ volts, and this it does independent of the speed of the dynamo or the consumption of current, and whether the dynamo and accumulator are working in conjunction or not.

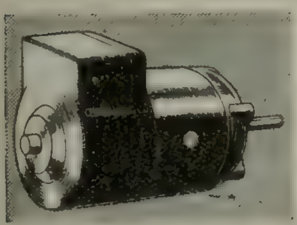


Bosch switchboard.

The Bosch Magneto Co., Ltd., 204, Tottenham Court Road, London, W.

The B.R.C. Dynauto.

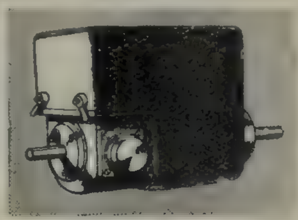
In the B.R.C. Dynauto the generator is of the constant voltage type, and is a bi-polar machine, being exactly like an ordinary continuous current dynamo, except for having a shunt excitation winding. In circuit with this special winding is provided a resistance, which is short-circuited by a vibrator. The latter is attracted by an electro magnet on which are fitted two coils, one of fine wire in shunt with the poles of the dynamo, and the other of thick wire placed in series in the circuit. The purpose of the latter winding is to limit the current given by the dynamo; indeed, if this winding did not exist, the voltage would be absolutely constant, but if the dynamo were to be connected with the battery accidentally while the latter were in a very discharged state, there would be a considerable flow of current from the dynamo into the battery. The addition of the thick wire winding in this case intervenes slightly to lower the voltage of the dynamo, and so limit the intensity of the current. The working of the machine is as follows:



The B.R.C. No. 1.

When the voltage obtained is equal to that for which the vibrator has been adjusted, the vibrating blade is attracted by the electro-magnet, and the additional resistance, which is in the excitation winding, is thrown into circuit. The effect is immediately to produce a drop in the voltage, and the blade resumes its position, short-circuiting the resistance. It will be seen that a very rapid succession of attractions throwing in and short circuiting the resistance takes place, thus producing a perfectly constant average voltage. This constancy of current is dependent upon a complex electrical phenomenon, which can only be compared with what is known in mechanics as inertia.

We give illustrations of two types of the B.R.C. Dynauto, No. 1 having an output of eight watts at eight volts, and No. 2 an output of 150 watts. In both cases the machines are thoroughly well protected against the ingress of dust or dirt, and in the larger type it will be noticed that the armature shaft is continued at each end, so that the dynamo can be placed as an intermediary between the magneto or the water pump and its drive. The vibrator, the windings of which also operate the minimum cut-out, is contained in a case attached to the dynamo itself, and it should be mentioned that pure tungsten points are used in order to make it practically unnecessary for any adjustment to be made to this part. It is claimed that, owing to the absolutely perfect maintenance of a constant current with this dynamo, and the fact that it can be used to light the lamps direct, in emergency, the capacity and size of the battery are very considerably reduced, especially as the machine reaches its maximum output at a very low engine speed.



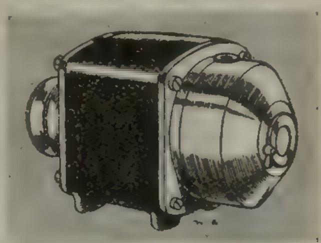
The B.R.C. No. 2.

Two types of switchboard are made—one a very simple affair with three tumbler switches, and the other a more elaborate instrument with combined voltage and ampère meter fitted in a neat German silver case.

Fenestre, Cadisch and Co., 171, Great Portland Street, W.

The Brolt Dynamo.

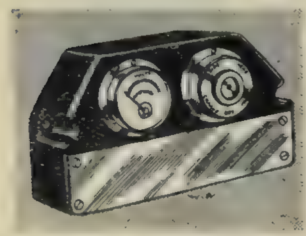
This dynamo is available in three sizes, viz., 42 watts, 6 volts, and 90 watts and 180 watts, both 12 volts. In each case the principle of current regulation is identical. Briefly described it is as follows: The carcase of the dynamo contains ordinary main wound poles with two small auxiliary unwound poles at right angles. The brushes, which are wide and bear upon two or three segments of the commutator, supply an excitation current to the wound poles through a shunt winding in the ordinary way. When the armature is revolved, a voltage is induced between the brushes as in any ordinary dynamo, and the dynamo commences to charge the battery as soon as the necessary speed is reached. The load current in the armature exercises a cross magnetising tendency, which creates a magnetic flux in the auxiliary unwound poles provided to receive it.



The Brolt.

The armature coils, short-circuited by the brushes, cross this flux, and, in consequence, have a short circuit current induced in them which is proportionate to the cross flux and to the speed of rotation. The direction of this short circuit current is such as to directly demagnetise the main wound poles, and as this effect is exactly inversely proportional to the speed of rotation, it follows that the output remains constant as soon as a certain speed is attained.

In the actual construction, two pairs of brushes are used. In some of the machines the unwound poles simply consist of the sides of the iron carcase. The Brolt dynamo is claimed to generate at a very low speed, and the maximum output is attained very quickly owing to the rapid rise of current that occurs. In consequence, the gear ratio of 1½ times the engine speed is usually quite sufficient.


The Brolt switchboard.

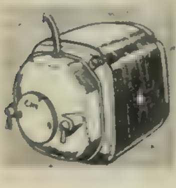
Two types of switchboard are made. In the larger size, the switch is of the rotary type, the various positions occurring by means of an engraved indicator behind a glass window let into the middle of the board. Above this is a combined volt and ampère meter, which is brought into action by a small push switch. Close by is a red glass covered lamp, which acts as a tell-tale for the tail lamp, with which it is wired in series. A plug adapter is fitted, and the whole of the front of the board being hinged, all the connections are readily accessible. The smaller board illustrated is of quite a different design, but also contains the same instruments with the exception of the tail light indicator. A special type of switchboard is made suitable for low built scuttle dashboards.

Brown Bros., Ltd., Great Eastern Street, London. E.C.

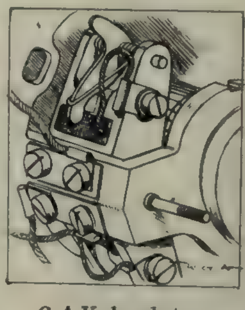
The C.A.V. Dynamo.

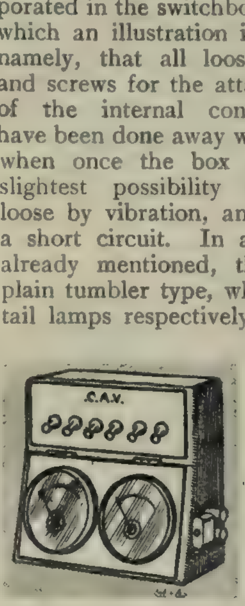
A special feature of the C.A.V. dynamo is the complete absence of cut-outs of any form, that is to say, with the exception of the self-contained dynamo there are no working parts whatever, and the installation may, therefore, be justly described as the simplest possible.

The principle upon which the dynamo is made to regulate its output automatically is not such as can be readily understood by anyone who is not an advanced electrician. It will suffice to say, however, that by means of cross magnetisation of the armature the magnetic flux is caused to excite a couple of unwound poles, which act in opposition to the two-wound subsidiary fields, the result being a balanced effect between the two and prevention of current increase beyond a certain maximum. The dynamo is self-contained, as shown in the accompanying sketch, a second sketch illustrating the arrangement of the brush gear which embraces, it will be noted, quadruple carbons, which are arranged so as to take the greatest possible advantage of the cross-magnetisation principle.


C.A.V. dynamo.

Instead of a minimum cut-out being employed to disconnect the dynamo from the batteries when the former is running at an unproductive speed, or standing still, a very ingenious use is made of a simple free wheel device in the driving pulley, and the battery can, therefore, run the dynamo as a motor without having to overcome the load of the engine; only the armature revolves, and this but slowly, and since it is mounted on ball bearings, the consumption of current in these circumstances is exceedingly small, and not enough to do the battery any harm. A charging switch enables this action to be discontinued when the car is standing still for any length of time. An especially good point is incorporated in the switchboards, of which an illustration is given, namely, that all loose joints and screws for the attachment of the internal connections have been done away with, and when once the box is completed there is not the slightest possibility of any small parts working loose by vibration, and so causing a derangement or a short circuit. In addition to the charging switch already mentioned, there are five others, all of a plain tumbler type, which control the head, side, and tail lamps respectively. Volt and ampère meters are fitted, and in addition to the inspection lamp plug adapter, provision is made for immediately renewing, if necessary, a fuse which is inserted in the main field circuit to guard against damage to the dynamo in the event of its being run accidentally with the battery disconnected.


C.A.V. brush gear.



C.A.V. switchboard.

The C.A.V. installations comprise a large variety of fittings, including lamps, electric horns, etc., which are made in several sizes, both for pleasure cars and commercial vehicles, and of the former, the sizes are 45 watts, 60 watts, 90 watts, 100 watts, and 150 watts.

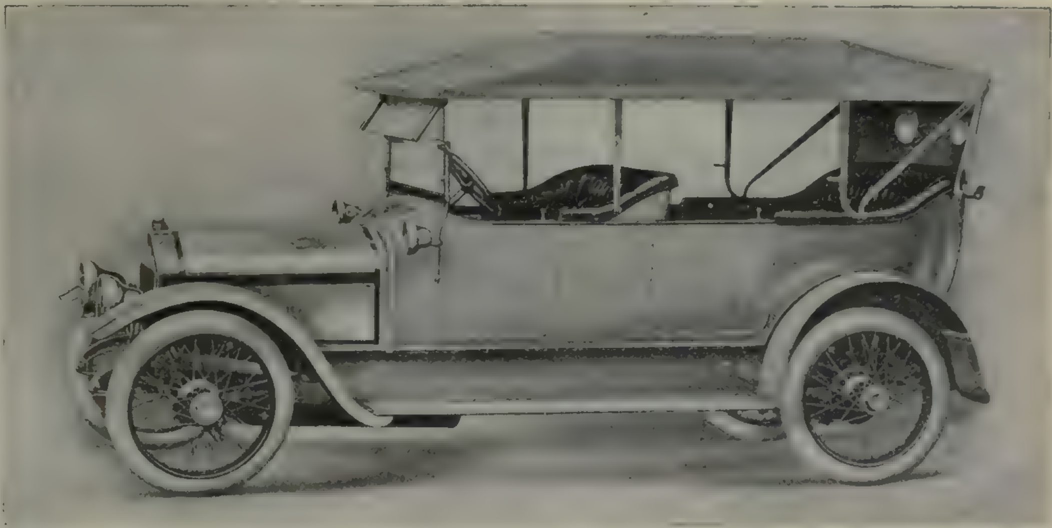
Messrs. C. A. Vandervell, Ltd., Warple Way, Acton, London, W.

The Dependence Dynamo.

The dynamo included in the Dependence electric lighting set is of a simple and robust type, giving an output of 120 watts or 10 ampères at 12 volts. The regulation of current is effected automatically, the two field magnets are shunt wound, but the pole pieces are of a peculiar shape which causes an opposing current to be generated in the field windings of a strength dependent on the distortion of the magnetic fields, which is again proportional to the armature speed.

Above a certain point, which is coincident with the attainment of the maximum output of the dynamo, the magnetic flux actually decreases, owing to this cause, and, in conjunction with the reaction in the armature coils, keeps the dynamo output to its pre-determined limit. The brush gear is very neat and strong.

In order to prevent the battery discharging through the dynamo unproductively, an automatic minimum cut-out switch is arranged at the commutator end of the armature-shaft, and is external to the main casing, but enclosed in a glass-fronted screw cap, through which its working can easily be seen. It is of the mechanical type and is of a very simple order, having



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All six-cylinder cars are fitted with the Wolseley patent compressed air self-starter and automatic tyre inflator.

Send for Colonial Catalogue No. 15, post free.

THE WOLSELEY TOOL & MOTOR CAR CO., Ltd., Adderley Park, BIRMINGHAM.

Proprietors: VICKERS, LIMITED.

LONDON DEPOT: York Street, Westminster S.W. **MARINE DEPT.: Columbine Yard, Cowes, I.O.W**

but one moving part. It works on the centrifugal governor principle, and consists of a semi-circular shoe anchored at one end and having the movement of its other end restrained by a coil spring. At low speeds this shoe is out of contact, but when the speed is sufficient to cause the centrifugal force to overcome the tension of the spring, which is at about 750 revolutions per minute of the armature, the movable shoe-piece moves outward and completes the battery circuit.

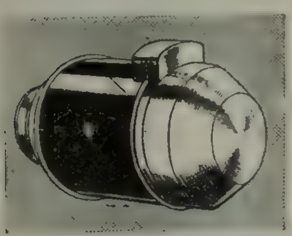
The switchboard consists of an aluminium box, in the sloping top of which are mounted the ampère meter, which is always in circuit with the dynamo and the volt meter, which is connected to the battery by pressing a small push button. The switches are of the tumbler type, two controlling the head lights separately, one the two side lights, one the tail lamp, and one the dynamo circuit. A plug is provided on one side of the board for the inspection lamp cable.

Peto and Radford, Ltd., 100, Hatton Garden, London, E.C.

The Ducellier Dynamos.

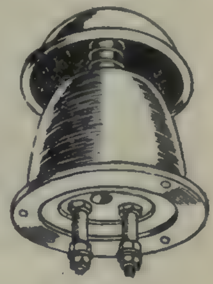
There are two distinct types of Ducellier dynamos, one is quite a new introduction and possesses important points of its own. The other, which has been on the market some considerable time, deserves to be briefly described. It consists of a permanent magnet dynamo, in which regulation of current is effected by strengthening or weakening the permanent magnetic fields by means of a wound pole, which is supplied with current from a brush, the position of which is adjustable, so that various outputs can be allowed for in order to suit different requirements of lamp load, etc.

The whole of the machine is enclosed in an aluminium casing, and is held down on sliding rails by means of a quickly detachable metal strap. By this means the tension of the belt is readily adjustable without the necessity of cutting it. The use of permanent magnets enables the dynamo to cut-in effectively at a very low speed, and to generate a working current of considerable intensity. The new type of dynamo embodies a secondary form of windings round the electro magnets, which has the effect of maintaining the voltage of the machine constant under all conditions as soon as the maximum of output is reached, as the dynamo loses its excitation in direct ratio to the intensity of the current it is producing under the influence of its own speed, thus keeping the voltage constant.


Ducellier dynamo.

When the dynamo begins to revolve slowly, the battery delivers all the current to the bulbs. This current passing through the series field windings fully excites the dynamo, and the voltage rises very rapidly with the speed until it soon becomes high enough to close the automatic switch. From that moment the dynamo is producing more and more current, whereas that delivered by the battery is gradually decreasing, until the speed of the dynamo becomes sufficient to balance the current from the battery. At that moment the current is reversed in the circuit of the battery, the dynamo supplying the whole of the current and re-charging the battery until it is fully charged. The automatic cut-out is a well designed unit, and is carried in a metal case separate from the switchboard. It provides a positive break, and it is claimed that under no circumstances can the blade stick.

The armature has two contacts, one of platinum and the other of carbon, the latter playing the part of arc breaker. The solenoid which controls it is wound with two coils of fine wire placed as a shunt across the terminals of the dynamo, whilst the moving armature supports a coil of thick wire, through which the current of the dynamo passes. When the voltage of the dynamo drops below that necessary to connect the automatic switch, the current changes its direction in the thick wire winding and reverses the poles of the armature, which is then repelled by the fine wire winding of the coil, and the contact is broken. A return current of .2 of an ampère is sufficient to cause the cut-out to break the circuit between the battery and dynamo.

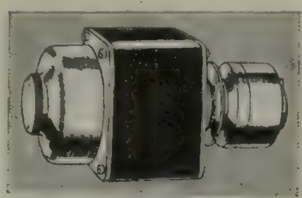

Ducellier patent dimming switch.

Under the same cover as this automatic switch is a security apparatus of quite a novel kind. This device, which is of quite a simple form, comes into operation in case of any accident to the battery or the wiring, and if such occurs causes the lamps to flicker very pronouncedly. It absolutely prevents either the battery or the bulbs being damaged by any excess of voltage which might be generated by the dynamo in case of short circuit. Another important innovation in connection with the New Ducellier is the introduction of a patent "dimming switch," which is connected to the head lamps so that upon pressing one foot upon a small pedal arrangement the light from these lamps can be dimmed to any desired extent. The action is a simple one, and merely consists in placing a resistance in circuit with the bulb. A sketch of this apparatus is appended.

The E.B.C. System.

The dynamos of the E.B.C. systems are made in three sizes, namely, 100 watts, 150 watts, and 225 watts. The two smaller can be used with an 8 volt circuit, but the larger works with a pressure of 12 volts. The maintenance of a constant current of output is obtained by the employment of the specially designed slipping clutch carried on the pulley, which is mounted on the armature spindle through which the dynamo is driven. This slipping clutch consists of two cones, which are normally held together by a spring and thus give a positive drive.

Connected to them is a multiple centrifugal governor, which, when a certain pre-determined speed is achieved by the armature, causes the two halves of the clutch to be held apart, so that slipping takes place and there is no further rise in armature speed. Owing to the neat design of this mechanism, the number of wearing parts is reduced to a minimum, and friction only takes place between the two cones, which are made of a substance which renders them practical proof against wear. By these means, the dynamo is definitely prevented from giving more than a certain voltage, and it is possible, therefore, in an


E.B.C. dynamo.

emergency to disconnect the battery altogether and supply current to the lamps direct from the generator.

The brush holders, which are completely enclosed, are of the box type, and contain square brushes of ample section, so as to ensure long life and absence from sparking. Incorporated with the E.B.C. clutch is a simple form of free wheel, which performs the same function as an automatic electric cut-out, inasmuch as it prevents the battery discharging through the dynamo and motorising it against the load of the engine. The free wheel device allows the armature to be motorised by itself, and the loss of current in this case is so small as to be negligible. The clicking of the pawl and ratchet, however, reminds the driver to switch off the main dynamo circuit when the engine is stationary. The switchboard used in connection with the E.B.C. system is of neat appearance and of compact size. It consists of a wooden box faced with metal, and contains a volt and ampère meter, both of which are in permanent connection with the dynamo and battery. The control of the dynamo circuit and of the lamps is effected by two rotary switches, the connections which these effect being shown by small dials above the turn-buttons.

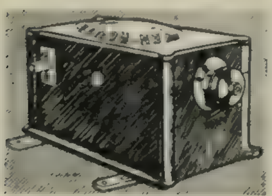
E.B.C. switchboard.

Bransom Kent and Co., Ltd., Great Eastern Street, E.C.

The En Route Dynamo.

This is a well designed dynamo of small size, suitable for small and medium powered cars. It is so made as to give thoroughly satisfactory service when mounted in an exposed position on the footboards, to which end it is of box form, as shown. The dynamo is shunt wound, and is connected direct to the accumulators, whence leads are taken to the lamps.

It is made in two sizes, one having an output of twenty-five watts, and the other sixty watts, both using a four volt circuit, though the sixty watt machine can be wound for an eight volt circuit. The smaller size cuts in at 1,400 r.p.m., and reaches its maximum output at 1,900 r.p.m., whilst the larger machine cuts in at 1,000 r.p.m. and gives its maximum at 1,400 r.p.m.



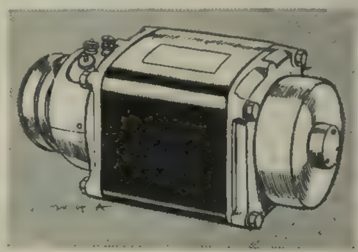
The En Route dynamo.

Although the machine is fully enclosed, ready access is provided to the commutator by means of a revolving lid, held in position by a bolt and spring catch. The carbon brushes are easily removed by undoing two screws. Contained in the dynamo case is a very simple form of electro-magnetic cut-out. In addition to preventing the dynamo running as a motor, this cut-out renders the dynamo inoperative whilst the car is being reversed. It may be mentioned that, owing to the use of a round belt for driving this installation, a certain amount of automaticity is obtained, as at very high speeds the belt tends to slip somewhat through the large centrifugal force acting upon it. Thus a more or less constant supply of current is maintained.

Motor Accessories Co., 55, Great Marlborough Street, London, W.

The Lithanode Dynamo.

In the Lithanode installation, the method adopted for regulating the current supplied to the battery is of a distinctive type. The dynamo differs in no important particular from a generator of the ordinary commercial pattern, and, hence, it has no liability to suffer damage from overheating. The output is 100 watts, or 8 ampères at 12 volts. It can also be supplied wound for 8 and 4 volt circuits. Between the battery and the dynamo is interposed a length of special resistance wire, the correct dimensions of which have been obtained by Messrs. Lithanode, Ltd., after exhaustive experiments on many and various materials. This resistance is of quite a different type from the ordinary metal wire sold for this purpose, and, in addition to possessing the property of only allowing a certain pre-determined current to pass, it allows this current very quickly to reach its maximum. No matter how much the voltage of the dynamo increases beyond this point, there is no corresponding increase of current passed to the battery.



Lithanode dynamo.

The advantages of this system are that there are no working parts to wear, as the resistance wire is indestructible, and absolutely certain in action. It also acts as a safeguard on the battery, inasmuch as in the remote event of a short circuit developing in the dynamo, it prevents more than the ordinary charging rate of current passing, and therefore no harm can be done to the plates in the cells. The dynamo, which we illustrate, is very neat in appearance and proof against ingress of foreign matter. The method by which the circuit between the dynamo and battery is disconnected at low speeds consists of a switch operated by centrifugal force and carried inside the dynamo itself on the armature spindle. This switch is exceedingly simple and embodies a double contact arrangement, which gives absolute security. The resistance wire or regulator is strung between two plates in the form of a reel, and is contained in a perforated metal case. As the regulator disposes of the surplus energy in the form of heat it can easily be used for warming the car in winter, for which purpose it can be arranged as a foot warmer. The Lithanode switchboard is of a sloping type, the case being made of wood with a metal front. It comprises a volt and ampère meter, between which is a small push switch for throwing the former into circuit. The main switches are of the tumbler type, all the connections being easily got at by swinging open the front.

Lithanode resistance.

The Lithanode Co., 100, Queen's Road, Battersea, London, S.W.

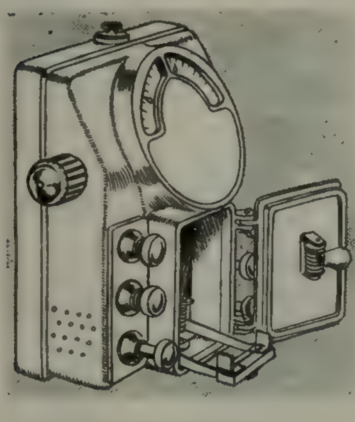
The Lodge Dynamo.

Simplicity and reliability have been the special points to which attention has been devoted in the Lodge lighting set. The generator illustrated follows the lines of a magneto in design, is but little larger, and of the simplest possible type, the only working part being the armature, which revolves between six permanent magnets. The use of a permanent magnetic field ensures a rapid rise of current at low speed and a uniform rate of increase up to a certain point, beyond which the current output remains constant, whatever the increase in speed, owing to the presence of armature re-action. The brush gear is of very massive proportions and is entirely enclosed in a waterproof case, the main cable being conducted thence through an insulated bushing.

Lodge dynamo.

In order to prevent the battery discharging through the dynamo, a simple form of electrical cut-out is used, and is carried on the switchboard, but as an additional precaution a free-wheel is fitted to the pulley on the armature shaft, so that if the armature should be motorised it does not work against the load of the engine, but runs very easily, absorbing a very negligible quantity of current, and indicating by the clicking of the pawl over the ratchet that the charging switch has been left closed when the engine is stopped.

The switchboard is a neat piece of work, having its case formed of cast aluminium, the upper part of which is devoted to two very neatly arranged meters showing voltage and also the ampèrage of charge and discharge; these are illuminated at night. The main circuits are controlled by half a dozen push-in positive switches, which can easily be operated by foot if desired. Between the two rows of switch buttons is a box containing the electric cut-out, and also the main circuit fuses, all of which are speedily accessible by opening the hinged lid. A twin-pin plug adapter is mounted on one side of the board for supplying an inspection or dashboard light, whilst Messrs. Lodge also manufacture a special resistance which enables an ignition battery to be charged direct from the main dynamo circuit.



Lodge switchboard.

Lodge Bros. and Co., Wrentham Street, Birmingham.

The Lucas Dynamo.

All the dynamos now made by Joseph Lucas, Ltd., are electrically controlled; that is to say, the output of current is automatically regulated without the adoption of any mechanical devices whatever, nor are there introduced any additional working parts in the machine beyond those which are found in a commercial dynamo. It is claimed that the generator commences charging at a very low rate of speed and that the output quickly rises to its maximum, and, no matter what further increase of armature speed takes place, the current remains constant.

These machines are made in three sizes, namely, 8 volts 6 ampères, 12 volts 8 ampères, and 12 volts 12 ampères. In each case the design and construction are exactly the same, they being of the bi-polar type with the armature running on ball bearings and all working parts completely enclosed against dust or wet. The Lucas set can be had with either one or two alternative switchboards, one of which, the de luxe type, contains an ampère meter and a voltmeter, brought into operation by push switches and illuminated at night by an enclosed glow lamp. The charging and lamp connections are effected by push-in positive switches.

New model Lucas dynamo.

The switchboard of the 8 volt set is of a similar type, which contains only an ampère meter and three switches. In both cases, the electro magnetic cut-out which disconnects the dynamo from the battery, when the former is running at an unproductive speed or is stationary, is contained in the switchboard itself, all parts of which are readily accessible.

Lucas switchboard.

J. Lucas, Ltd., Great King Street, Birmingham.

The Mira Magnetolite.

The Magnetolite system consists essentially in employing a permanent magnetic field to excite the armature, which rotates between the magnet poles, and, furthermore, to use the fixity of this magnetic field to limit the output of the dynamo at high speed, so that heavy currents do not destroy the accumulator or burn out the lamps. The accompanying sketch clearly shows the arrangement of the dynamo itself, which is furnished with twelve square type permanent magnets which render the machine very compact. The design is simple, and the only working part is the armature, which runs on ball bearings. Inside the aluminium driving pulley, which is keyed to the armature shaft, is a mechanical minimum cut-out, which disconnects the dynamo from the battery when the former is rotating at low speed or is stationary.

Mira Magnetolite.

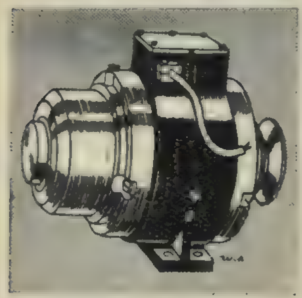
This consists of a small balance weight working by centrifugal force against the action of a spring which tends to keep the contacts separated. As soon as a certain speed is achieved, the contacts are forced together and the circuit is closed. In the wiring used in this installation, armoured cable is employed with a single live conductor to convey the current, the return from the lamps being *via* the armouring or frame back

to the battery and base of the dynamo, and thence by the mechanical cut-out to the negative brush. Two types of switchboard are available with this set, one is upright and of desk pattern with a couple of rotary switches controlling the charging circuit and the lamp connections and having a voltmeter in permanent circuit. The second type, which is especially adapted for scuttle dashes where space is limited, is narrow and shallow and has four push-in positive switches for the various circuits and a separate volt and ampère meter, the latter showing charge and discharge.

The High Tension Co., Belvedere Road, Westminster, London, S.W.

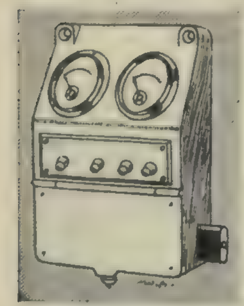
The P. and H. Dynamo.

The Powell and Hanmer car lighting dynamo, which gives 90 watts, or 7½ ampères at 12 volts, is of an extremely simple type, and is so arranged that the control of the electric current is effected automatically by means of special windings, which are introduced into the main fields. The design is extremely compact and incorporates a novel feature in the fitting of the automatic cut-out switch upon one of the main magnetic poles of the dynamo, thereby securing a very positive and very powerful action of the switch, both in cutting in and also in cutting out the batteries as soon as the speed falls below a certain figure and the output of the dynamo is insufficient to charge the accumulators.



P. & H. dynamo.

The brush gear, which is neatly arranged, is carried under a dustproof detachable end plate, and it will be seen that the general form of the machine is such as to lend itself easily to fitting on almost any car. The sketch which is given of the switchboard shows the neat construction of this unit. It is an all-metal box with a sloping top, which carries a volt meter and an ampère meter, both of which are permanently in circuit. Underneath these are four tumbler switches, one of which controls the dynamo charging circuit, whilst the others apply to the head, side, and tail lamps respectively.



P. & H. switchboard.

On the right-hand side at the bottom of the board is a detachable plug for adapting to an inspection or dashboard light. The whole of the lower portion of the switchboard front is hinged, so that all the dynamo and battery connection, etc., can be immediately got at. This lid also gives access to the replaceable fuse carrier.

Powell and Hanmer, Ltd., Cheston Road, Aston, Birmingham.

The Riches Dynamo.

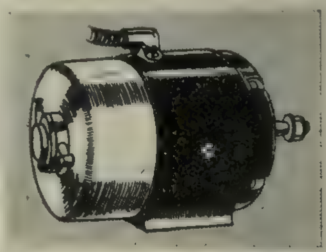
The dynamo electric lighting set made by this firm is a comparatively small type, intended for low-powered cars, and more especially designed for three lamps only, that is to say, two head or side lamps and a tail lamp. The output is eighteen watts, three ampères at six volts at 2,500 r.p.m. The dynamo is designed to be carried on the running board or inside the chassis, and to be driven from the engine or clutchshaft by a round belt. It is of the ironclad waterproof type, and is specially designed to run satisfactorily in an exposed position.

In circuit with the dynamo is an automatic electric cut-out, all the parts of which are thoroughly enclosed. As the "break" always occurs when the dynamo voltage and the accumulator voltage are practically balanced, there is little, if any, current passing, and, therefore, no sparking occurs at the contacts, which, being platinum, are practically everlasting. The dynamo is used continually to charge the battery, and armature re-action is depended upon to prevent the voltage rising to an excessive point. The whole of the installation is extremely simple and practical, though quite efficient, and comprises, in addition to the head or side lamps and tail lamp, a special switch, a four volt accumulator, and a pair of volt and ammeters mounted on a small board.

G. T. Riches and Co., 19, Store Street, London, W.C.

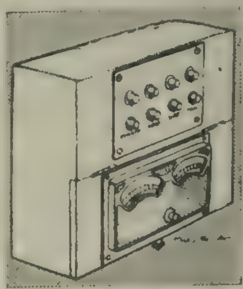
The Rotax-Leitner Dynamo.

This dynamo is available in four sizes, all of which work at 12 volts and give respectively 90, 110, 150, and 300 watts. The current regulation is dependent upon the inherent design of the dynamo itself, whereof the following explanation indicates the method of working.



Rotax dynamo.

Instead of only two brushes, as in the commercial dynamo, there are four, the subsidiary brushes being placed at right angles to the main ones, and the field magnets being shunt wound. At starting, there is a difference of potential between the subsidiary brushes, and this current being in series with the field windings assists their excitation, but as the current flowing out of the armature at the main brushes increases, the armature flux increasingly distorts the field flux in the direction of rotation, and, in consequence, the voltage between the subsidiary brushes is first reduced to zero and then reversed in sign—in other words, counter e.m.f. is introduced in the field circuit. Increases in speed produce corresponding increases in the counter e.m.f., so that in effect the field is weakened proportionately, keeping the voltage on the battery constant irrespective of speed variation.



Rotax De Luxe switchboard.

Several types of switchboard are made, of which the De Luxe is illustrated. This is carried out in aluminium. It contains separate volt and ampère meters controlled by a push switch and positive in and out switches for the main circuit. One model is sold which is specially designed for use with low scuttle dashboards, and there is also a small type made for light cars.

Rotax Motor Accessories Co., 43, Great Eastern Street, London, E.C.

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The Colonial Car

and built to stand up to its work for years.

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SPECIFICATION—Engine 80 mm. x 150 mm., 4 Cyls., 4 Speeds, Zenith Carburetter, Bosch Magneto, Forced Feed Lubrication, Centrifugal Pump Cooling, Bevel Drive, 815 x 105 Dunlop Tyres, Wheelbase 10ft. 3½in.

EQUIPMENT—Includes everything ready for the road: Cape Cart Hood, Single Adjustable Glass Screen, Leitner Dynamo Lighting Set, 5 Detachable Wheels, Steel-studded Tyre for the Spare Wheel and Full Kit of Tools.

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15·9 h.p. „	**£285**	..	**20·1 h.p.**	**£350**

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CARS

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1914 PROGRAMME.

Horse Power.	Body.	Price.	Price with complete Equipment.
10-12	Chassis	**£230**	
"	Standard 4-Seater body	**£280**	**£300**
"	Standard 2-Seater body	**£270**	**£290**
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EQUIPMENT includes Cape Cart Hood, Single Wind-screen and Dynamo Lighting Set (5 Lamps), 5 Detachable Wheels and Steel Studded Tyre to spare wheel. Equipment on closed cars means the addition of Dynamo Lighting Set. Acetylene Head and Oil Side and Tail Lamps to 10-12 h.p. Model only. Leather Hood to Victoria Car, **£5** extra.

DIMENSIONS.

H.P.	Cylinders.	Bore and Stroke.	H.P. by R A.C. Rating.	Engine Capacity C.C.	Number of Speeds.	Final Drive.	Weight of Chassis. Cwts.	Qrs.
10-1	4	80 x 120	15·9	2409	3	Bevel	12	2
12-15	4	80 x 120	15·9	2409	4	Bevel	16	2
15.9	4	80 x 150	15·9	3012	4	Bevel	18	3
20·1	4	90 x 150	20·1	3816	4	Bevel	18	3

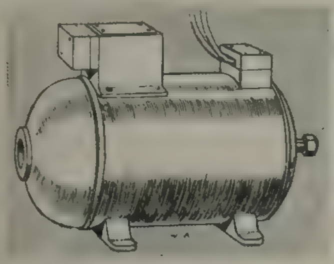
H P	Ignition.	Wheel Base.	Track	Overall Lengths.	Body Space. ft. in. ft. in.	Tyres Dunlops.
10-12	Bosch Mag.	8ft 4½in	4ft. 3in.	11ft. 7in.	6 7½ x 2 7½	810 x 90
12-15	Bosch Mag.	10ft 0in.	4ft. 5½in	13ft. 6in	7 9 x 2 10	810 x 100
15 9	Var Mag	10ft. 3½in	4ft 9in.	14ft. 4½in.	7 9 x 2 10	815 x 105
20·1	Dual Mag	10ft. 3½in	4ft. 0in	14ft. 4½in.	7 9 x 2 10	820 x 120

Chassis of Landaulettes and Limousines are six inches longer than above, and price is **£10** over standard

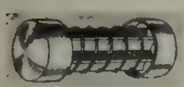
The Star Engineering Co., Ltd.,
Wolverhampton,
ENGLAND.

The Rushmore Dynamo.

Highly ingenious and simple are the means which are adopted in the Rushmore dynamo for the production and regulation of a constant current, especially as in this case no additional working parts are employed The dynamo is shunt wound, and the shunt field coil is connected so that it receives current at all times at the constant voltage of the battery. The field magnets are furnished with another winding which is known as a "bucking coil," namely, one which is so connected as to oppose the main shunt field coil. This coil, the effect of which is to reduce the field excitation, is connected as a shunt across an iron ballast coil, of which we annex a sketch. The ballast coil consists of a certain length of iron wire, which has the peculiar property of possessing an electrical resistance which is practically constant below a certain critical temperature, above which the resistance increases enormously with each degree of temperature rise. The resistance of the bucking coil is considerably greater than that of the ballast coil, when the latter is cold or only warm, so that at low speeds practically all the current generated passes directly to the battery, and the machine acts as a simple, unhampered shunt dynamo.



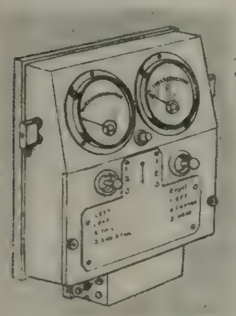
Rushmore dynamo.



Rushmore ballast coil.

The iron wire will allow, however, only a certain number of ampères to pass, after which the resistance suddenly increases, so that any excess current cannot pass, but must go through the field "bucking coil," which thus at high speed comes into action and chokes down the excitation. By suitably selecting the length of iron wire resistance, the output of the dynamo can thus be made absolutely constant.

Two sizes of Rushmore dynamo are made, 100 watts and 150 watts, both working at six volts. By using this low pressure of current, very sturdy filaments can be employed in the lamps, so that there is less likelihood of breakage, and better optical efficiency can be obtained. Carried on the dynamo casing is an automatic electro-magnetic cut-out, which disconnects the batteries from the dynamo at such times as the latter is not giving enough current towards the former.



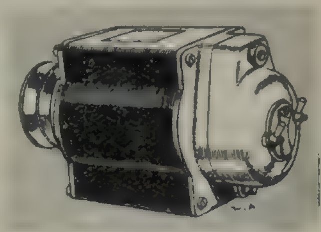
Rushmore switchboard.

The switchboard is of desk form, and is made of aluminium. It contains a volt and ampère meter, which are in permanent connection with the dynamo, but the latter can be switched into circuit with the battery on pressing a push-button. There are two tumbler switches, each of which has three positions, one of them controls the charging circuit and the head lamps, whilst the other applies to the side and tail lamps. Two-pin adapter plugs are fitted at each side. Underneath the switchboard, and contained in a ventilated case, is the iron ballast coil, which is so arranged that its heat can do no harm to any part of the apparatus.

Rushmore Lamps, Ltd., 46, Brewer Street, Piccadilly Circus, London, W.

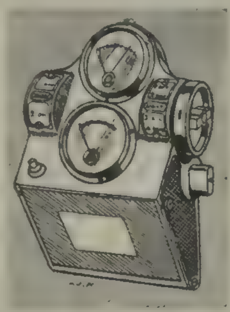
The Smith Dynamo.

S. Smith and Sons have recently introduced a new dynamo lighting installation, in which the dynamo is made under licence from Trier and Martin's patents. It is of the constant voltage type, in which the regulation is obtained by a special arrangement of windings, which will now be shortly described. The commutator is provided with four brushes, two of which, the main ones, are fixed in the usual neutral position, whilst the auxiliary brushes are ninety degrees in advance, and these are connected to their respective main brushes through suitable external resistances. The main brushes supply the main field magnet windings in the ordinary way.



The Smith constant current dynamo.

As the armature begins to revolve and e.m.f. is set up between the two main brushes (due to residual magnetism), the effect is to produce, in conjunction with the flow of current in the resistances between the main and auxiliary brushes, a magnetic flux in the armature, and, in consequence, to strengthen the main field. This state of affairs continues until the armature is revolving at extremely high speed and begins to generate the pre-determined voltage between the main brushes. As the speed is further increased an armature reaction takes place, which has the effect of displacing the axis of the field forward, so reducing the current in the resistances. When the axis of the magnetic field is displaced 45° there is no current at all between the main and auxiliary brushes, as they are at the same potentials; any further increase of displacement causes a current to flow again between the main and auxiliary brushes, but in a reverse direction, with the result that the magnetic field is weakened and the machine becomes self-regulating. It is claimed that with this system of winding the Trier and Martin dynamo is the smallest machine (other conditions being equal) for its output, and that the temperature rise is exceedingly low.



Smith's De Luxe type switchboard.

We give an illustration of the dynamo, which is mounted on sliding rails, which allow the belt to be easily tensioned. The second illustration depicts the de luxe switchboard, which is made of metal and is an alternate type to the standard model, which is in wood and rather differently arranged. In the de luxe type, the volt and ampère meters are above one another, and the charging and lamp connections are effected by two rotary switches; an adapter is also fitted, and the lower portion of the board is hinged so that the internal connections are easily accessible.

S. Smith and Sons, 179, Great Portland Street, W.

Electric Car Lighting Systems.

The Spiral Dynamo.

This is an ingeniously constructed dynamo, giving a constant output, and the principle of construction is neat. The regulation is accomplished entirely by the axial movement of the armature.

The armature with its commutator and brush gear is built up on a steel sleeve, which is a sliding fit on the shaft, the latter having spiral grooves formed therein, which encircle the shaft. The sleeve with the armature, etc., carries steel balls, which are held in pockets recessed in the sleeve, and are in position to engage with the grooves in the shaft. When the armature shaft is stationary its position is arranged so that the core is in relation to the magnet poles north and south, as is the case in a dynamo having a fixed armature of the ordinary kind. It is held in that position by a coil spring at one end, which abuts against a shoulder fitted with an adjustable collar.

Spiral dynamo.

The brush gear and brushes are adapted to slide axially with the armature, the latter at slow speeds, and when generating its required output maintains its normal position relative to the magnet poles, but with increase of speed it cannot remain in that position, as the torque reaction of the armature becoming greater causes it to wind along the shaft, taking up a position in a less powerful magnetic field, and thus compensating itself for the increase of speed. The action is, of course, reversed on reduction of speed.

The regulation of current obtained in this manner is said to be so efficient, and the output so constant, that the lamps can be lit direct from the generator without fear of their filaments becoming damaged. The automatic circuit breaker, which cuts in and out the dynamo connection with the battery, is a mechanical device operated by the armature The switchboard for use in this set is of quite an individual pattern, and is very small; the main switch is, in appearance, similar to that of a small clock, the dial being spaced and clearly marked for each distinct control, and a pointer being operated by means of a small milled edged button projecting through the centre of the glass.

There is also a switch for the dynamo and an ampère meter and a volt meter, together with an inspection lamp plug. An illuminating lamp is arranged over the whole, and this is in series with the tail lamp so as to act as a tell-tale, but it can also be switched on and off independently as required.

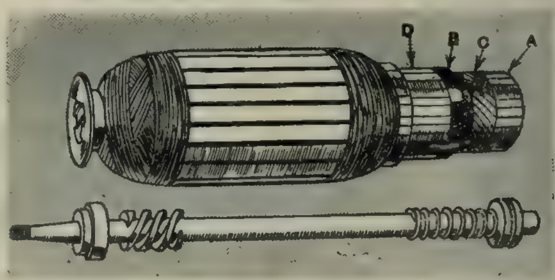
The Spiral Regulating Dynamo Co., Ltd., 13, West Street, Shaftesbury Avenue, London, W.C.

The Stereos Dynamo.

In this generator a most interesting and ingenious method is adopted to provide absolute constancy of current output as well as to dispense with an additional automatic switch. In regard to the shape of the armature and its winding and the poles and their windings, etc., the Stereos dynamo exactly follows generators of the ordinary type. Reference to our sketch herewith will show, however, that the commutator is of quite an individual form. It consists of four parts, whereof A has straight segments for the excitation brush to make contact with when the machine is running at low speeds or at rest, B is an insulated part on which the main brushes rest when the machine is running at very low speeds or when it stops, C is a portion having segments arranged obliquely for the excitation or field brush to rest on and make contact with at varying speeds beyond that at which the machine "cuts in," and D has straight segments on which the main brushes make contact when the dynamo is running and making current.

The armature is arranged to move longitudinally along its axis of rotation guided by its spindle, at the end of which is a worm thread, which engages with an internal worm cut in the driving end of the armature itself. The latter is normally forced sideways on the worm spindle by a coil spring. When it starts to rotate, the dynamo, by reason of the fact that the excitation brush is in the position giving the maximum current to the field circuit, immediately begins to generate current. This sets up a braking effect upon the armature, which, as the speed rises towards the point at which this effect is strong enough to overcome the spring, begins to move along the worm thread, and when the speed is sufficient for the dynamo pressure to overcome that of the battery the main brushes make contact. This puts an increased braking effect upon the armature, causing it to slide along the worm thread, so that practically the whole brush surface is making contact upon its commutator.

As speed increases still further, the armature moves along its shaft, causing the excitation brush to move on the oblique part of the commutator, this armature movement corresponding with the speed variation, either weakening or strengthening the current, through the field circuit, in just the right proportion



Sketch showing peculiar design of the Stereos armature and spindle.

A Straight segment for excitation brush.
B Insulated part on which main brushes rest.
C Obliquely arranged segments.
D Straight segments on which the brushes make contact.

to give a perfectly constant output from the machine at all speeds above 1,500 revolutions per minute, and effects perfect regulation with the greatest efficiency. The effect of actually moving the armature with its obliquely set commutator is exactly the same as though the brushes were moved from the point of maximum field density into one of less strength. It will thus been seen that the Stereos dynamo regulates itself, and closes or opens the circuit at exactly the right moment, quite independently of any external device. It is also impossible for it to be left in circuit with the battery when the speed is too low for it to charge this latter, as the slightest reverse current definitely puts the armature out of circuit at once.

Four sizes of dynamo are made, namely, 8 ampères 8 volts, 8 ampères 12 volts, 12 ampères 12 volts, and 12 ampères 16 volts.

Jozot, Ltd., 59-61, New Oxford Street, London, W.

Electric Engine Starters. By Horace M. Wyatt.

Part I.—The Requirements and the Electrical Principles Involved.

RECENT exhibitions in London and Paris have sufficed to show that the fitting of engine-starters, at least to the heavier class of touring car, is undoubtedly upon the increase, and that the type most favoured is the electric starter. In view of these facts, it may be interesting to give a little attention to the principles involved in designing and applying a device of this kind. In so doing, we need not deal in detail with a large number of specific systems, as one can obtain a clearer idea of the position by classifying the various electric engine-starters upon the market, and using single instances as examples illustrative of principles that may come under discussion.

Broadly speaking, electric engine-starters may be divided into three classes as follows:

Class I.—Systems in which two separate machines are used for the purposes of engine-starting, and of providing electric light for the car.

Class II.—Systems in which one electrical machine performing dual functions is employed both for engine-starting and for providing electric light, but is not embodied in the power plant or transmission of the car.

Class III.—Systems in which the duties of engine-starting and electrical lighting are both undertaken by a single machine, which is worked into the design of the car mechanism so as to form an integral part of it.

If we consider these three classes comparatively, the following points seem worthy of attention:

A system coming under Class I. is not so compact as it might be. In involves the provision of two drives for the electric motor and dynamo respectively. It involves also the use of two sets of field magnets and two armatures, whereas in each case one can be made to serve the purpose. On the other hand, it has the advantage that it lends itself to the independent consideration of the best possible way of designing electrical machinery for a single known purpose, and therefore the two machines taken separately should each be more efficient in its own sphere than a single machine required to undertake two classes of work which are altogether different, and in some respects involve contrary conditions.

Systems coming under Class II. suffer from the difficulty that the proper speed of an electric lighting dynamo is usually quite different from that at which most engine-starting motors would be driven by the car engine when running under its own power and connected to the electrical machine by the transmission used for starting purposes. Consequently, if the machine used is to be as small as it can be made compatible with efficiency, it appears that it is necessary to have two separate transmission systems between the dynamotor and the car engine. As compared with Class I., weight is saved by dispensing with one set of field magnets and one armature. A second commutator and a second set of armature windings are also dispensed with in some designs. The field magnet windings employed when the machine is running as a dynamo will not, however, do the work required when it is running as a motor, and two windings are therefore necessary.

By adopting a system coming under Class III. the need to keep down the size and weight of the dynamotor as far as possible is more or less eliminated, since it can be embodied in, and form a part of, the engine flywheel. Extra weight is in this way made available without any serious drawback, and so it becomes possible to make the machine do its work efficiently at a comparatively low rate of revolution, namely, the same speed as the car engine. In any system involving the use of a single dynamotor it does not seem to be advisable to use metallic brushes, which have a much higher conductivity than carbon brushes, and would be quite satisfactory if employed only for the occasional work required of a starting motor. (Class I.) For a machine in regular operation carbon brushes are preferable, as they do not cause so much wear of the commutator, but they are certainly not ideal on a motor required to take a very big current for a very short time without opposing unnecessarily resistance of its flow.

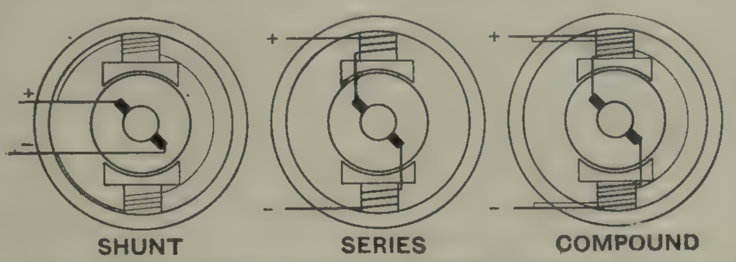


Fig. 1.—Three diagrams showing the principles of shunt, series, and compound windings.

Systems coming under Class III. must necessarily be substantial enough to avoid the risk of damage in the event of the engine backfiring while being started, and with the other systems some device may be employed to disengage the electric motor if a backfire takes place. The attempt to deal with two requirements by using one machine also puts out of court some of the most ingenious of the methods employed for limiting the output of car lighting dynamos, and so safeguarding the lamps and the accumulators.

In comparing these three systems frequent reference has been made to the dynamotor. This is, of course, a machine capable of working either as a motor or as a dynamo. It is, in fact, what is called a reversible machine. The duty of a dynamo is to take mechanical power, and in its absorption to produce electrical power. The duty of an electric motor is exactly the opposite. Some machines of quite simple design and with quite simple windings are reversible, but it does not follow that they would be suitable for the particular duties under discussion. As a matter of fact, a car-lighting dynamo must necessarily be what is called a shunt-wound machine; that is to say, the coils which energise the field magnets must be connected across the terminals of the dynamo, so forming a shunt from the main circuit through which a limited amount of current is permitted to pass. A series-wound machine would be quite unsuitable for the work for a variety of reasons into which we need not enter. If, however, the machine is run as a motor and shunt field connections

Electric Engine Starters.

are employed it will not be well adapted to exert the great torque that is necessary for engine starting. What is wanted is a series-wound motor; that is to say, one in which the field coils actually form part of the main circuit. When a heavy current is sent through the coils of such a machine the field magnets are at once very much more strongly magnetised than would be the case were the other type employed. Consequently, the dynamotors coming under Classes II. and III. all have both series and shunt field windings, only one of which need be employed at a time. It is, however, possible to obtain certain results often required in electrical practice by having both series and shunt field windings continually in use. A machine so fitted is said to be compound-wound. The three methods of wiring are shown diagrammatically in fig. 1.

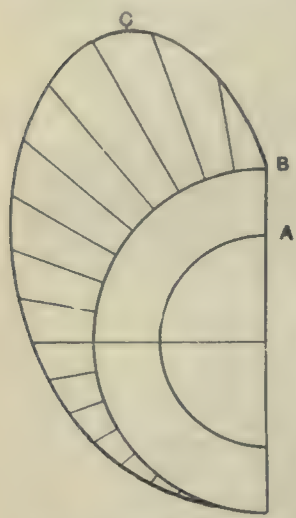


Fig. 2.—Diagram showing the variations of turning effort in engine starting.

A, crank pin path
B, curve of engine friction
C, curve showing total resistance to turning engine

The whole weight of electric starters in Classes I. and II. represents a new duty put upon the motive power of a car. In the case of those coming under Class III. a part at least of the weight must be recognised as a disadvantage accompanying their adoption. Within limits, the weight of an electric machine may be kept down by utilising to the full the magnetic properties of the best soft malleable iron. Up to a certain point, the strength of an electro-magnet is proportional to the current used to bring it into existence. If the only point aimed at is efficiency of the electric machinery, no attempt is made to keep down weight, and the degree to which the parts are magnetised is intentionally limited. The reason for this is that there is a limit beyond which magnetisation cannot proceed, and as this limit is approached, the amount of extra current needed to give a certain extra magnetisation is considerably increased. The magnet is said to become saturated, and when this process is complete, no additional amount of current can give it any more strength.

In the case of an electric starting motor, the saving of weight is perhaps even more important than high electrical efficiency. Consequently, the size of the field magnets and of the armature is kept down as far as possible, and the parts are very highly magnetised. It is possible also to reduce weight in this particular instance, because the machine is not required to run continuously under heavy load. An electric motor is to an extent self-regulating in the matter of its output. In other words, the more is expected of it the more it will do, but if it is required to go on doing too much for any length of time, the heat generated in the attempt would be so considerable as to cause a breakdown. If the weight of a starting motor were brought down to an irreducible minimum in view of the work to be done under normal conditions, there would be trouble directly any slightly abnormal circumstances, such as a cold engine or faulty carburation, intervened.

There is an unfortunate lack of really reliable information on the subject of the power needed to start a motor car engine. We know that this power varies with the temperature of the engine and the consequent viscosity of the lubricating oil, and we also know that the force which must be applied to turn an engine varies with the positions of the pistons. This is, of course, due to the compression of the gases before ignition, and in the case of a four-cylinder engine the maximum resistance is felt at two points in each complete revolution.

Fig. 2 shows in diagrammatic form the variation of turning effort needed during a compression stroke. When the piston reaches its top position, the compression is at a maximum, but as the piston is no longer moving against the compression, the latter does not affect the power required to turn the crank. Consequently, the curve of turning effort drops to meet the curve of engine friction at the point B. The shape of the curve of turning effort is dictated by two factors, one being the degree of compression opposing the upward movement of the piston, and the other being the amount of upward movement corresponding to a given angular movement of the crankshaft. During the second half of the stroke, the upward movement of the piston for a given angular movement of the crank is continually decreasing, while the resistance of the compression against the upward movement is continually increasing. A combination of these two factors produces a curve somewhat as shown, indicating that the greatest effort is required when the crank is something like 25° from vertical.

Fig. 3 is a chart which was published some time ago in an American paper, showing the effort required to turn a four-cylinder engine at various speeds, and the effect of the temperature of the engine and lubricating oil on the turning effort needed. Assuming this chart to be sufficiently correct to serve as an example, a little preliminary consideration of the relation between turning effort and power is needed before we can estimate approximately the output of an electric starter which would suffice to do the work in this instance. Power is measured in foot-pounds, the unit being the amount of power used in applying a force equal to the weight of one pound, and maintaining the application of this force for a distance of one foot. In calculating the turning effort or torque, we are dealing not with power as such, but with leverage. In estimating the torque applied to the starting handle of an engine, we should want to know the amount of force exerted on the handle, and the length of the handle; or, in other words, the leverage over which the force acts. We are still dealing with force and distance, and consequently our unit is still connected with pounds and feet, but in this case, to avoid

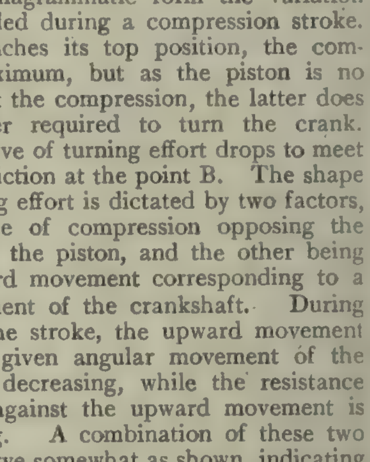


Fig. 3.—Chart showing the starting effort, at various speeds and different temperatures, of a four-cylinder engine $4\frac{3}{4} \times 5\frac{1}{4}$in. (120 × 133 mm.)

confusion, the unit is called a pound-foot instead of a foot-pound, and the two things are by no means the same. If we exert a force of one pound at a radius of one foot for a complete revolution, the amount of work done is one pound moved through a distance equal to the circumference of the circle, the radius of which is one foot; that is to say, the work done is 2π foot-pounds.

If we assess π at its approximate value of $\frac{22}{7}$ we then see that torque in pound-feet $\times 2\pi \times$ the number of revolutions made per minute = the work done in foot-pounds per minute. Horse-power is that power which is capable of doing 33,000 foot-pounds of work per minute, so that power in horse-power = torque in

$$\text{pound-feet} \times \frac{44}{7} \times \frac{\text{r.p.m.}}{33{,}000} = \frac{\text{pound-feet} \times \text{r.p.m.}}{5{,}250}$$

Turning to the chart (fig. 3), if we take the lowest point of the lower curve we see that the torque required is about 40 foot-pounds at 170 r.p.m. Substituting these figures in the question given above, the horse-power required is found to be about 1.29 h.p.

Taking a lower rate of revolution, say, 50 r.p.m., the curve shows that the foot-pounds are about 55, and substituting again in the equation we find the necessary horse-power to be about .52 h.p. In this way it is possible from a chart like fig. 3 to estimate the power which must be applied to a crankshaft to rotate the engine at a given speed, assuming a given temperature.

In assessing the required output of an electric motor we must deal in electrical rather than in mechanical units. Electrical current is measured in ampères, and the pressure at which it is supplied is measured in volts. The product of these two is called a watt, which is a small unit of electrical power. As a matter of fact, 746 watts are required to equal one horse-power, and consequently when we have found the necessary horse-power, as in the examples given above, the results must be multiplied by 746 to give the corresponding number of watts. Thus, in the first example, 1.29 h.p. $\times$ 746 = 960 watts.

We have just said that a watt is the product of volt into ampère. In the case of an electric-starting motor we know approximately the voltage at which it must work, since this is dictated by the number of cells employed. Each cell on discharge gives about two volts, so that a battery of six cells gives twelve volts. Following up our example and dividing the 960 watts by the number of volts, namely, twelve, we find that the current in this case must be 80 ampères.

As a matter of fact, a motor only capable of giving the power represented by eighty ampères at twelve volts would not be adequate for the purpose, even if we assume 170 r.p.m. to be a sufficient speed for starting the engine without risk of failure. There is necessarily some loss of power in the electric motor and its transmission, and for this reason alone we must allow at least 20%, which means that the motor must be able to give 100 ampères at twelve volts. This calculation refers to motors in Class III., and makes no allowance for the relief afforded by providing transmission with a low gear ratio between the motor and the engine.

Then again, reference to the chart shows that if the temperature happens to be low and the lubricating oil consequently sticky, the torque required at 170 r.p.m. is 60 instead of 40. This increases the duty on the starting motor by 50%, indicating that the motor must be capable of taking for a short time—without damage to its windings—a current of no less than 150 ampères at twelve volts. If the motor were stated to work at twenty-four volts, the necessary current would, of course, be halved. If, on the other hand, it were designed to work at six volts the current would be doubled, and so on. These figures suffice to give a general idea of the requirements which have to be taken into consideration in proportioning a starting motor and the transmission through which this motor is to turn the engine crankshaft.

Here again, however, we are faced with special considerations which must have their effect on design. Among these is the need for providing that the motor shall get to work more or less gradually, or else shall be capable of overcoming the initial resistance of the engine before rotation of the crankshaft begins at all. Even then, there is always the possibility of a back-fire, which would put a sudden and very considerable strain on any positive transmission connecting the starting motor to the crankshaft. Some manufacturers make special provision to meet this contingency, and reference will be made to the various means adopted.

Then again, the power required for starting can be obtained either by employing a comparatively heavy electric motor designed to take a big current and to run at a moderate speed, or, in the other extreme, by fitting a comparatively light electric motor capable only of taking a moderate current even for a short time, but working at a very high speed through a reduction gear of big ratio. In the latter case some steps must be taken to ensure that the car engine when running rapidly shall not rotate the electric motor at so high a speed as to be injurious to it.

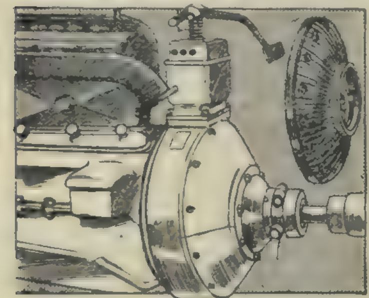
Part II.—The Leading Features of the Principal Electric Starters.

As an example of a reversible machine actually embodied in and forming an integral part of the car mechanism (Class III.), we may take the U.S.L. system as applied to the Sheffield-Simplex cars. In this system the dynamotor comprises an eight-pole field magnet, the poles of which carry both shunt and series windings. Instead of having the armature rotating in the space between the field magnet poles, as is more usual, in this instance the armature is outside the field magnets, and takes the place on the engine crankshaft usually occupied by the fly wheel. This arrangement allows the greater part of the weight of the iron used in the magnetic circuit to be employed in the rotating mass which performs a useful function irrespective of the electrical effects obtained. The stationary field magnets, which are rigidly secured in the dynamo housing, are comparatively light, so that only a small proportion of the weight of the dynamotor is additional weight over and above that which would be carried if the car were not fitted with an electrical equipment. The frame which carries the eight brushes bearing upon the commutator is quite light, being of aluminium. In this system there is, of course, no question of gearing. The dynamotor rotates at the same speed as the car engine, and therefore must be—and, in fact, is—a machine of considerable power. The battery providing current consists of twelve cells of 100 ampère hours capacity. When the machine is being used as a starting motor, these cells are all in series, and the motor therefore works at about twenty-four volts. When, however, the machine is functioning

Electric Engine Starters

as a dynamo, the cells are connected in two parallel groups of six, so that it is only necessary for the armature to be rotated at a speed capable of resulting in the generation of a current at about twelve volts before the charging circuit can be closed. The machine is put into operation as a starting motor by the depression of a starting button protruding through the footboard. When the engine has started the button is released, and this movement serves to operate a switch so designed as to give the necessary connections for charging as soon as sufficient engine speed is attained. At high engine speed the output of the dynamo is regulated by the use of the opposed series and shunt windings on the field magnets, but when starting up these windings act not in opposition to, but in support of, one another, assisting the starting motor to operate effectively with great rapidity. In the case of the Sheffield-Simplex car, the starting motor turns the engine at something between 250 and 300 r.p.m. The whole system is simplicity itself, and will serve as a good example to illustrate the essentials of a starting and lighting dynamotor.

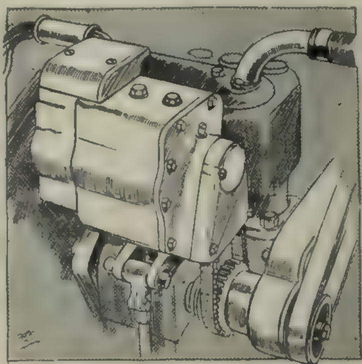
When we come to Classes I. and II. there are, as already mentioned, additional points which require consideration, since the starting motor must then be connected to the engine crankshaft by some form of gearing. The ratio of the gears fitted between the starting motor and the engine crankshaft varies very much, being more or less proportional to the weight and power of the starting motor. As something approaching an extreme instance at one end of the scale, we may take the White motor generator. This machine is mounted in a convenient position by the side of the engine of the White car, to which it is connected by gearing giving a ratio of 2.6 to 1. To ensure certainty of action at this low motor speed, a half compression device is fitted to the engine. The possibility of injury by backfire is eliminated by the interposition of friction gearing. The same gear ratio is employed when the machine is running as a lighting dynamo, and the rate at which it is rotated even with high engine speeds is never so great as to necessitate the use of any speed limiting device. The White system has given good results in the hands of many motorists during the past two years.



The U.S.L. as fitted to the Sheffield-Simplex The dynamotor is coupled direct to and forms an integral part of the engine. The armature replaces the ordinary flywheel, and with its commutator is shown separately in the right hand top corner. (*Class III.*)

The U.M.I. North East equipment is in some respects rather similar, the gear ratio being about 3 to 1, and the drive from motor to engine being a positive one. The armature has only one commutator and one winding. The field magnets are of the four-pole type and are compound wound. Regulation of output for charging purposes is secured by a relay controlled by the main circuit current, but operating by varying the resistance in the field circuit. The same gear is used for starting and lighting. The system is simple and well thought out, and appears to be thoroughly efficient

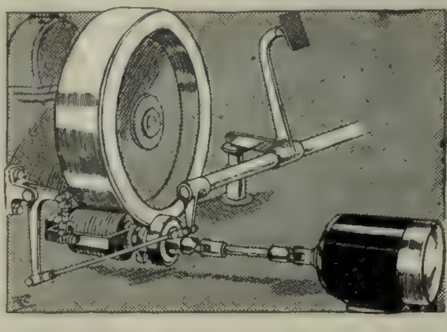
As an example approaching the other extreme of gear ratio, we may mention a system known in the United States as the Hartford. This comes under Class I., and the work of starting the engine is done by a little motor running normally at about 9,000 r.p.m. The reduction gear between the motor and the engine gives a ratio of something approaching 75 to 1. Pressure on the starting handle first of all sets the electric motor in motion, thus storing up energy in the rapidly revolving flywheel on the armature shaft. A further movement engages a friction clutch, and brings this stored-up energy to bear on the work of starting the engine.



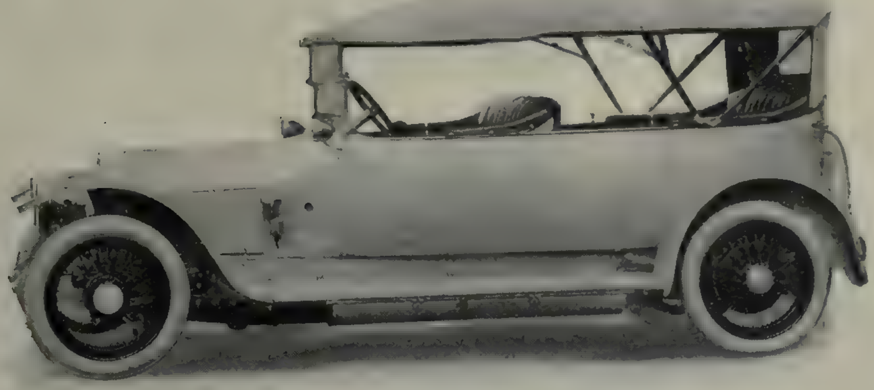
The White system. The same gearing is used for starting and charging. A compression relief device is provided on the engine for easier starting. The gear ratio of the dynamotor drive is 2·6 to 1. (*Class II.*)

Before returning to a few more examples of Class II. it may be mentioned that a certain number of manufacturers of starting motors seem to imagine that the presence of a free wheel somewhere in the system gets over any trouble that might be caused by backfiring. As a matter of fact, this is not the case, for a back-fire does not reverse the direction of the resistance which the engine opposes to the starting motor, but merely increases that resistance very greatly.

Among the devices included in Class II. is the Delco, which is familiar as the system employed on the Cadillac cars. The armature has two independent windings and two commutators, and there are also two independent windings on the field magnets. The windings employed when the machine is used as a starting motor are thus entirely distinct from those used when it is working as a dynamo. For starting purposes, pressure on a button switch causes the armature of the machine to rotate slowly. This facilitates engagement of the gear wheel on the armature shaft with the teeth on the engine flywheel, this engagement being brought about by pressure on the clutch pedal. When the gears are connected, a swinging motor brush



The U.M.I. equipment. The final drive is by friction roller brought into contact with the flywheel by the pedal shown, which simultaneously operates the starting switch. The starting motor is provided with planetary reduction gear. The total gear reduction between the armature shaft and the friction roller is 18 to 1. (*Class I.*)



LANCIA—the Colonial Car.

Pre-eminently it is the car for the Colonies. It is dependable in a special degree; sturdy, powerful, silent, and distinctive. It possesses perfect radiation, a quality developed where its great hill-climbing qualities were developed—on the long-drawn Passes of the Alps. Ample clearance is provided, and a particular feature is the strong, light coachwork designed for colonial conditions. Moreover, there is the appeal and utility (in the 35 h.p. model) of the electrical equipment—engine starting and lighting—built into, and an integral part of, the chassis.

35 h.p. model, 110 x 130 (30 h.p. R.A.C. rating). The chassis de luxe. Rushmore engine-starter (operated from driving seat and no front starting handle fitted), and dynamo lighting outfit built into the chassis design. Klaxon electric horn, 5 feet half-elliptic rear springs, new patented foot-brake mechanism, tapered bonnet, and aluminium dashboard. The variable rake steering column carries no wires within or without. A full equipment of lamps, speedometer, wire wheels, with detachable rims fitted with 835 x 135 tyres. The most advanced and refined expression of automobile engineering extant. Very powerful, smooth, and silent. Special Colonial model. Inclusive chassis price .. **£591.**

15 h.p. model, 80 x 130 (15 h.p. R.A.C. rating), 4 cylinders, 4 speeds, with direct drive on third and fourth speeds, with detachable rims and 815 x 105 tyres. Chassis price **£380.**

Complete 4 or 5 seated open touring Car, including all lamps, speedometer, spare tyre, etc. .. .. **£555.**

20/30 h.p. model, 100 x 130 (24 h.p. R.A.C. rating), made in two lengths of wheelbase Complete with dynamo lighting installation, all lamps, Klaxon electric horn and speedometer, wire wheels and detachable rims included in chassis price. Special Colonial model .. .. **£511.**

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Siddeley = Deasy

The Motor Carriage of Perfect Comfort

SPECIAL Types are supplied, designed for Colonial use, all with Knight Sleeve Valve Engines, and provided with every luxury and refinement for the comfort of the driver and other occupants.

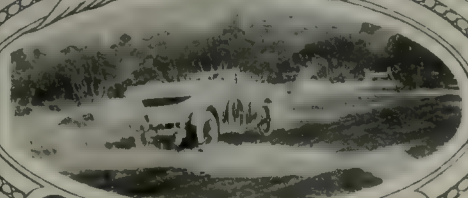
14-20 h.p. 4-cylinder,		
	with two-seater body	**£485.**
	with torpedo body	**£500.**
	with cabriolet body	**£600.**
18-24 h.p. 4-cylinder,		
	with two-seater body	**£600.**
	with torpedo body	**£630.**
	with cabriolet body	**£750.**

The above prices are for the car complete, delivery Coventry, ready for the road, with electric lighting equipment, 5 lamps, 5 detachable wheels, and 5 tyres. ¶ **We also manufacture the 30-36 h.p. 6-cylinder car, which is the most luxurious and perfect Motor Carriage.**

Makers of Luxurious Motor Carriages of Moderate Power.

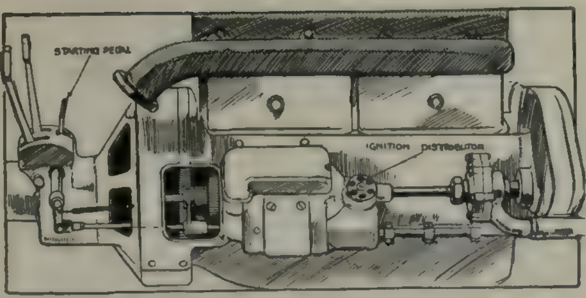
A Siddeley-Deasy outside the King's Palace, Bangkok.

A Siddeley Deasy in Ceylon.



A Siddeley-Deasy on the Cyrl Peninsula, S. Australia.

Godbold.



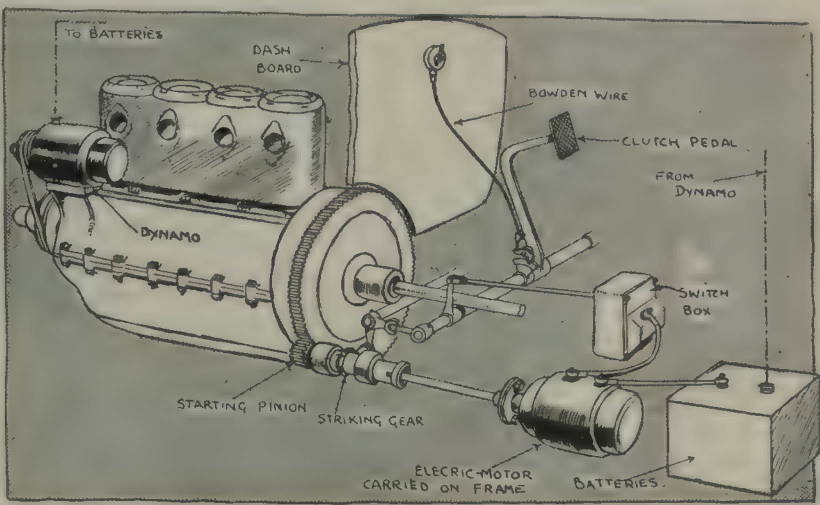
The Delco system, better known in this country as the Cadillac system, shown fitted to the Hudson engine. The dynamotor is driven for charging by forward shafting and drives for engine starting through compound sliding gear, a pinion being brought into mesh with teeth cut on the flywheel. (*Class II.*)

is simultaneously brought into contact with the motor commutator; the machine then changes from dynamo to motor until the car engine has been started, and release of the clutch pedal again reverses its functions.

The Scott starter provides for a reduction in the gears themselves of 7 to 1, and a reduction on the chain sprocket wheels varying from unity to 2½ to 1 for various applications of the machine. The transmission involves epicyclic gearing of which the planet pinions are carried on a disc wheel, on which is provided a large free-wheel which over-runs to prevent excessive speed if the band brake operated from the dash is left on when the engine is running fast. To prevent damage by back-fire, the inner race of a small free-wheel carried on the armature spindle is not keyed to the spindle, but is secured by phosphor bronze discs on either side of it, and forced against it by a spring washer. This method allows slip in the event of a back-fire, but is quite rigid enough to give a firm drive when the machine is working as a dynamo.

In the T.A.T. system a solenoid is used to prevent excessive speed, and also to guard against injury from back-fires. The solenoid holds the gears into engagement while the dynamo is for starting the engine, but immediately the engine starts, and the load on the electric motor is thereby reduced, the solenoid releases the gears automatically. The same solenoid in the event of a back-fire causes the gear wheel on the dynamotor spindle to rotate freely, and so temporarily disconnects the motor from the engine. The operation of the T.A.T. machine is very simple, and the system is one of the most ingenious.

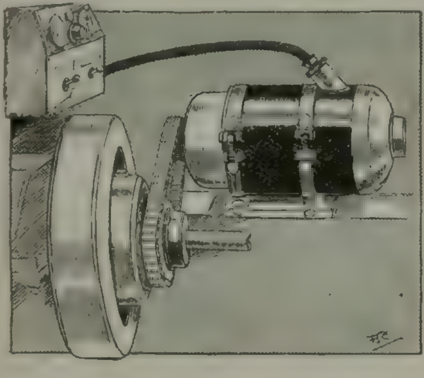
Quite a number of makers provide alternative systems in Class II. and Class I. Among these may be mentioned the Rotax. A combined machine of this make is connected to the engine by a silent chain with a ratio of 2 to 1. In the other system the separate starting motor transmits its power through helical gearing to a raw hide pulley, which is brought into contact with the periphery of the engine flywheel by the pressure of a pedal. This method of securing against injury from back-fire by some sort of friction drive is, as already mentioned, one of the most usual. It is, for example, used in the U.M.I. two-machine



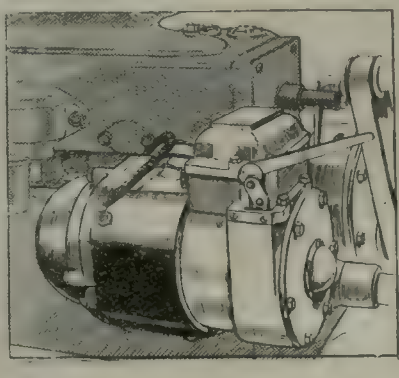
The Siddeley-Deasy equipment; Leitner-Rotax system. The striking gear and the starting switch can be so connected to the clutch pedal shaft, by Bowden mechanism, that by declutching the starter is brought into operation. When the clutch pedal is released the starter is disengaged and switched off. (*Class I.*)

system, which also includes the free-wheel method of allowing the car engine to over-run the starter. Similar in principle is the C.A.V. starter which has a gear reduction of 25 to 1, and is a neat and well-constructed machine used in conjunction with the separate lighting dynamo of the same make. The transmission of the starter is through planetary gearing. Two sizes of machines are built for cars of varying horse-power, the car engine being turned for starting purposes at a speed of about 100 to 140 r.p.m. For the purpose of being incorporated in the engine or gear box unit large types of gearless C.A.V. starters are also built.

It will be apparent from the variations noticeable in the different designs that there is a marked difference of opinion both as to the advisability of

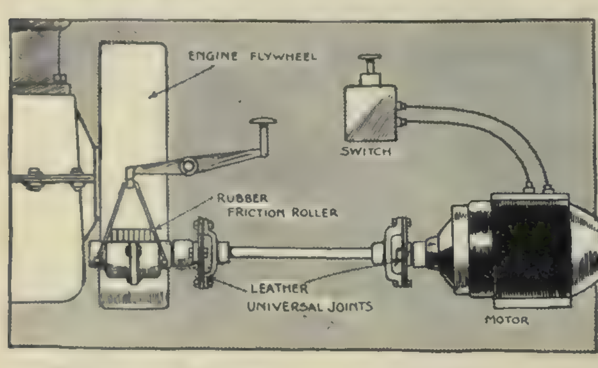


The T.A.T. lighting and starting equipment. The gears are automatically selected for starting or charging. The dynamotor is automatically disengaged by a solenoid operated mechanism if a back fire occurs. (*Class III.*)



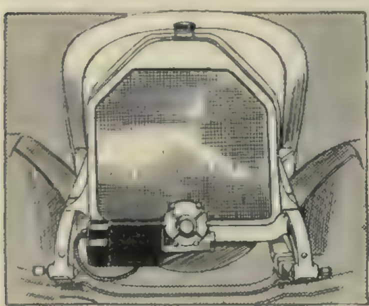
The Scott dynamotor. The operating lever actuates the switch and selects the gear for starting or charging. Provision is made against damage being caused by back fires. (*Class II.*)

combining the starter in the same machine as the lighting dynamo, and also as to the adoption of the friction drive. While some hold that this is in the nature of a makeshift, others point to its simplicity, the reduction of shock due to its use, its faculty of enabling the starter to take up its load gradually, and the safeguard that it gives against back-fire.



The C.A.V. system. The drive to the flywheel is by friction roller brought into contact by a pedal as shown. The current is switched on by a separate switch, and the starting motor is provided with planetary reduction gear. (*Class I.*)

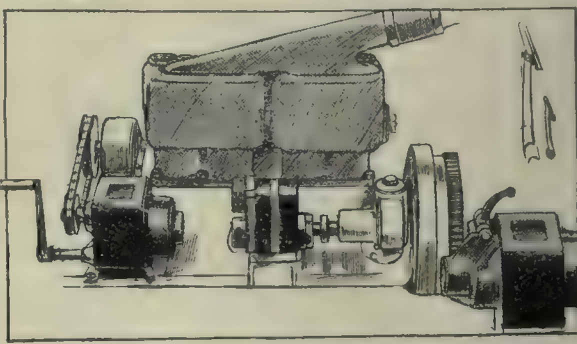
The systems favoured by the Arrol-Johnston Co. are the Disco and the Gray-Davis. The separate starting motor of the latter make has been used successfully for the heavy work of starting $3\frac{1}{2}$ ton lorry engines. The makers of the Disco machine also market a special motor under the name of the Disco Universal, which has been designed to be fitted easily to any car. It drives through worm gearing, which occupies the position usually accorded to the starting handle. It has been reckoned that when this system is applied to a car not fitted with a charging dynamo, the accumulators which accompany it suffice to start the engine from 300 to 1,000 times—according to its size—on one charge. It is, of course, generally a fairly easy matter to provide a drive for a lighting dynamo, and if the battery then put in is sufficiently substantial the Universal starting motor could be made dependent upon it.



The Disco Universal system, specially designed for fitting to existing cars. It replaces the usual starting handle, the necessary gear reduction being obtained by worm and worm wheel on to the front end of the crankshaft. (*Class I.*)

In this connection it may be mentioned that one of the most surprising things about the electric engine-starter has been the ability of secondary batteries to stand the extremely rough work to which they are subjected in operating such machines. There is no comparison between a good modern battery designed to stand a heavy discharge, and the old ignition battery rated at a similar capacity in ampère hours. In the majority of instances—but not in all—the rating on these ignition batteries was over-stated on the grounds that ignition work does not mean continuous discharge, and if the current taken when the ignition circuit is closed is, say, two ampères, the average current is reduced by the fact that the circuit is broken for a part of each revolution. Thus, a cell which would provide two ampères for ignition purposes during twenty hours' running was often marked as having a capacity of forty ampère hours, the true capacity being in fact only fifteen or twenty, and in some cases even this proved a generous estimate when the cells were tested under continuous discharge. An ordinary lighting battery is not expected to be discharged at anything quicker than about an eight hours' rate. Thus, a forty ampère hour battery might be discharged at the rate of five ampères. When working an electric starter the discharge will be very much heavier for short periods, and consequently specially stout construction of the battery plates is really demanded by the peculiar conditions.

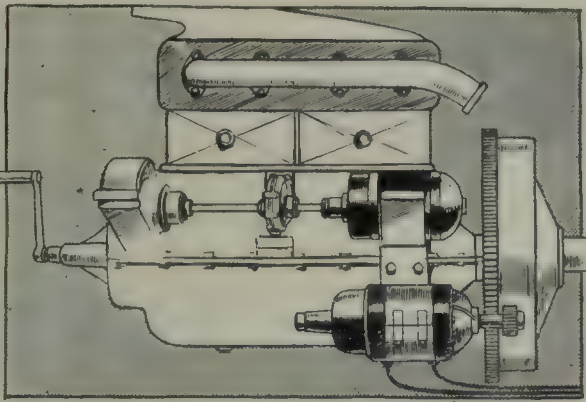
Returning for a moment to the means provided for preventing the car engine from running the starter too rapidly, reference should be made to a couple of very interesting systems. One of these is to be found on the Brolt starting motors. In this example the driving pinion is mounted on a quick thread cut on the armature spindle. When the motor starts, the inertia of the pinion causes it to pull along the thread, and so to come easily into mesh with the gear teeth on the flywheel of the engine. If the engine tends to run faster than the starter, the effect is to screw the pinion along its thread and put it out of engagement with the gear ring.



The Disco equipment as fitted to the Arrol-Johnston cars. The driving gear is brought into mesh with the teeth on the flywheel by operating the lever shown. The gear reduction is 20 to 1. (*Class I.*)

The other example, which is the same in effect but altogether different in method, is to be found on the Rushmore starter. In this instance the commutator is made sufficiently long to allow of end-ways movement of the armature and its shaft without breaking the connection between the commutator and the brushes. When the machine is at rest the armature-shaft is held by a spring in such a position that the pinion is out of mesh with the gear ring. Directly the motor begins to take current from the accumulators the armature is sucked into a central position between the field magnets, and at the same time it begins to rotate, these two movements bringing the pinion easily into mesh with the gear ring. As soon as the engine starts, the load on the motor is reduced, and the current which it takes is reduced correspondingly, with the result that the spring again overcomes the pull of the field magnets and pushes the pinion out of engagement. The gear ratio used with the Rushmore starter varies from 5 to 1 to 15 to 1, according to the size of starter used and the power of the car to which it is fitted.

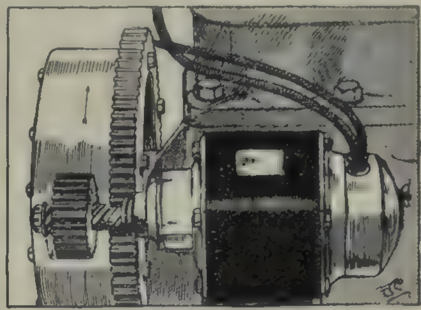
It will be noted that in certain instances no special provision appears to be made to eliminate risk of damage from back-fire. Some manufacturers consider that the best security is an ample reserve of power and strength, electrical and mechanical. It is argued that back-fire is only liable to occur if the engine is rotated very slowly, and that a sufficiently powerful starter will give a starting speed sufficient to put any such possibility out of court.



The Rushmore two-unit equipment. The armature of the starting motor slides axially when current is first switched on, and so brings the driving pinion into mesh with the teeth on flywheel. On switching off, or when the engine starts, the armature slides in the opposite direction, and automatically disengages the pinion. A single reduction gear is used of 9.6 to 1 ratio. (Class I.)

In summing up this brief general survey of electric starting systems, it may be said that an examination of progress, gauged by a study of exhibits at recent motor shows, seems to indicate quite clearly that the adoption of the electric starter will become very general on everything but the very lightest cars. It is stated that about 95% of the cars now being built in the United States have electric starters fitted as standard.

In describing the various systems, there is, unfortunately, every opportunity to give somewhat false impressions. At present there is a great difference between the detailed design and workmanship of various systems, whereas in a series of descriptive notes one's attention is naturally drawn to original or ingenious points, and it is difficult to give the due share of credit to systems which may be simple and unassuming, but yet more effective than others illustrating much scientific ingenuity but doubtful engineering skill. It strikes one that at present some starters have insufficient reserve of power to meet emergencies, and it is quite clear that an apparatus which fails to do its work just when that work is most difficult is not what we want. This is merely a transitory fault, and is only found in a few instances. More permanent disabilities are the additional weight involved when a starting motor is carried, and the very considerable price which has to be paid for a good equipment.



The Brolt system. The pinion for final drive is mounted on a quick thread. When the electric motor starts the inertia of the pinion causes it to lag and to screw into mesh with the teeth on the flywheel. Any tendency of the engine to drive the motor causes the pinion to screw out of gear. Direction of rotation is shown by the arrow. (Class I.)

Motoring in England and on the Continent.

Taxation and Customs Systems Explained.

IN order to assist Colonial motorists who come home and buy a car with the intention of doing a few months' touring in England and on the Continent before taking their departure, the following information relating to taxation systems and Customs formalities here and on the Continent has been prepared. A very small proportion of our Overseas visitors bring their cars with them, but they would only amount to about one per cent. of the total number. In such cases the visiting motorist is exempt from the local taxation licences if he does not stop in the country longer than four months. If he runs the car more than four months from the date of registration he has to take out a local taxation licence (see below). Then there are others who favour the policy of buying a second-hand car and selling it, perhaps at a sacrifice, before returning.

It will be assumed that the Colonial motorist has arrived in England, and is about to take delivery of a car. If he is wise he will have ordered it two or three months before leaving his home, as the principal manufacturers are never in a position to give immediate delivery at the time of the annual influx of visitors from the Colonies and Overseas Dominions. Of course, if one is easily satisfied and has no special requirements and ideas to be embodied in one's car, it is quite possible to buy one straight away from many of the London showrooms.

It is a very good plan to join either the Royal Automobile Club, either as a full member, or as an associate, which costs but one guinea, or the Automobile Association and Motor Union, especially if a Continental tour figures on the programme, as both these organisations are in a position to make all arrangements and offer suggestions for touring abroad. Particulars of both the Royal A.C. and the A.A. and M.U. will be found on pages 111-112.

Having got delivery of the car, the first thing to do is to obtain a driving licence (5s.), which may be obtained from any police office. There is no test to

undergo before the licence is granted. It must always be carried when driving, and produced to any constable upon demand. Police court cases of driving without a licence are not uncommon, so care should be taken to see that no run, however short, is commenced without this document being in one's pocket.

The motor car must be registered (£1 at any police office), and when this is done a number will be allocated. Number plates with the identification number and letters painted on must then be affixed at both the front and back of the car. A local taxation licence must also be obtained (from a post office), for which the charges are as follow:

	£	s.	d.
Cars not exceeding 6¼ h.p.	£2	2	0
Exceeding 6¼ but not exceeding 12 h.p. ...	3	3	0
,, 12 ,, ,, ,, 16 h.p. ...	4	4	0
,, 16 ,, ,, ,, 26 h.p. ...	6	6	0
,, 26 ,, ,, ,, 33 h.p. ...	8	8	0
,, 33 ,, ,, ,, 40 h.p. ...	10	10	0
,, 40 ,, ,, ,, 60 h.p. ...	21	0	0
,, 60 h.p.	42	0	0

The above classification is for touring cars only.

The horse-power is arrived at by R.A.C. rating, *i.e.*, $\frac{D^2 \times N}{2.5}$ where D = bore, N = No. of cylinders. The method of arriving at the h.p. is obviously unfair, as stroke is not taken into account, but it is the law, and although it has come in for a great deal of criticism, and at one time there appeared to be prospects of it being altered, everything at the time of writing points to motorists having to make the best of a very unsatisfactory state of affairs for the immediate future at any rate.

Another very unjust point of this taxation system, and one directly affecting those motorists for whom this article is especially written, is the fact that no concession is allowed to a motorist buying an English car, using it here a period of two months in England, and then taking it back with him to Australia. He has to pay the full year's taxation whether he is motoring in England twelve days or twelve months. The only concession made is in the case of a car kept and used for the first time in any year after October 1st, when the above amounts are reduced by one-half. The Colonial motorist visiting home in the summer is not generally in a position to take advantage of this concession.

Having obtained a driving licence, registered the car, and obtained a local taxation licence, all Great Britain and Ireland is open to the motorist. Those contemplating motoring for the first time at home may be somewhat deterred from doing so by the large number of police traps and the methods adopted by the police, which they have doubtless heard so much about during the past five years. This need not be so. There are comparatively few traps worked now, and the prejudice shown by police and magistrates towards motorists has greatly diminished.

The speed limit of twenty miles an hour may be habitually exceeded when road conditions allow, except in districts where the police are known to be active or where special speed limits exist. The rule of the road is to keep to the left and overtake on the right. Trams may be overtaken on the right or left according to circumstances.

Provided he has time, the Overseas visitor should most certainly take his car to the Continent, if it is only for two or three weeks.

Indian and Australian motorists taking cars back with them often do the Continent last, and then join their boat at Marseilles. Toulon, or Naples.

Before motoring abroad the two questions which arise are those relating to International Travelling Passes and Triptyques. International Passes and Triptyques are two quite separate things, and the why and the wherefore of each is explained herewith.

International Travelling Passes allow motorists to travel in countries which are parties to the agreement without the necessity of obtaining special driving licences and carrying special number plates for each country visited. The following is a list of countries accepting International Passes together with the distinguishing letters allotted to each:

A	Austria.	H	Hungary.
B	Belgium.	I	Italy.
BG	Bulgaria	MC	Monaco.
BI	British India.	MN	Montenegro.
F	France.	P	Portugal.
D	Germany.	RM	Roumania.
GB	Great Britain and Ireland.	R	Russia.
GR	Greece.	SB	Servia.
GBZ	Gibraltar.	E	Spain.
GBY	Malta.	S	Sweden.
NL	Holland.	CH	Switzerland.

Passes may be obtained in England only through the R.A.C. or the A.A. and M.U., the car and driver must undergo examination and a photograph of the driver and particulars of the car must be supplied. Cars are then provided with the identification letter or letters of the country to which they belong. This takes the form of a plate which is affixed to the back of the car generally just above or below the registration number. A plate also has to be fixed to the dashboard (facing the driver) on which is given h.p., engine number, weight in kilos, and country of origin of the car. Motorists are not legally obliged to obtain passes before travelling abroad, but practically everyone does, as they save such a lot of trouble and inconvenience.

Colonial motorists entering England with passes are charged a fee of £1 by the Customs officials at arrival ports for stamping their passes and registering their cars.

Triptyques are as necessary as International Passes and save one carrying a large amount of money and a deal of inconvenience. The amount covering the Customs duties (ruling in the countries it is intended to traverse) is deposited with either the R.A.C. or the A.A. and M.U., who then issue a triptyque which consists of (1) portion retained by Customs officials on entry, (2) portion left with Customs on final exit, and (3) portion retained by holder and forwarded upon return to the body with whom he has deposited the required amount. His full deposit is then returned to him.

Triptyques are available for the following countries: Austria, Finland, Holland, France, Italy, Switzerland, Belgium, Spain, Roumania, Russia, Norway, Sweden, and Denmark. There is in most countries a limit to the time for which they are available. Speaking generally, motorists exceeding three or four months stay will be liable to the ordinary taxes existing in the country in which they are staying.

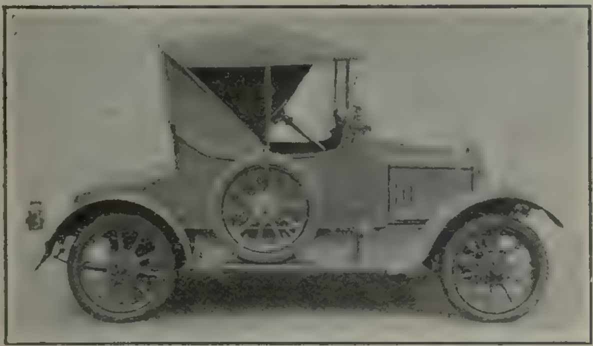
It will be noticed that Germany is omitted from the countries which have adopted the triptyque system; this is because the German Government alone of the European Powers is, at the time this book went to press, standing out of the agreement, but it is hoped that she will see her way to fall into line before long.

With the exception of Sweden, Portugal, some of the Austrian provinces, and some towns in Italy, the rule of the road on the Continent is to keep to the left and overtake on the left.

Progress of the Light Car.

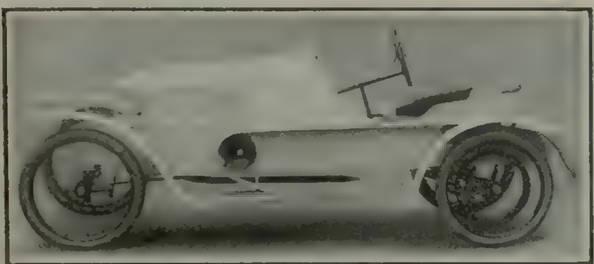
By the Editor of "The Light Car."

THE interest that has been displayed during the past two or three years in light cars of the inexpensive type has been brought about by a multiplicity of causes, principal among them being the importation of low-priced American two-seater cars; the ambition on the part of motor cyclists—or, to be more correct, sidecarists—to own and drive a vehicle with greater protection for their passengers than a sidecar provides; and the revival of the early types of voiturette which were the precursors of the modern motor car. At the time this book went to press there was almost a certainty that the light car would be defined by the R.A.C. and A.C.U. as a car with an engine not exceeding 1,400 c.c., weight being left out of the question. The "El Dorado" of all motorists not possessed of wealth is to be in the position to purchase for £100 a car which will do all that more expensive vehicles will achieve in the way of speed and power and yet be economical to run. Their desires have not yet been realised, but there are on the market a quantity of light cars at prices ranging from £125 to £200 which are really good value.



A miniature car, the four-cylinder 9½ h.p. Standard. This, like the majority of light cars, has a very complete equipment, including spare detachable wheel, five lamps and hood and screen. A third seat can be supplied if desired.

The connecting link between a motor cycle and a motor car was in 1912 defined as, and named by the A.C.U., the governing body of the motor cycle pastime, a cycle car, a vehicle with an engine not exceeding 1,100 c.c., and of chassis weight not exceeding 6 cwt. The makers of motor cycles took up the manufacture of this type of machine with avidity, and many designs which had been hurried through for the purpose of exhibition were shown at the Olympia Motor Cycle Show of 1912. A large number of them never appeared again, or, if they did, it was in a new and improved form. Good business was done in the class of small car with multi-cylinder water-cooled engine, shaft drive, and change speed lay-shaft gear box, but this type of vehicle can hardly be termed a cycle car, because it does not embody cycle practice, but has all the best attributes of a well-born motor car in miniature.

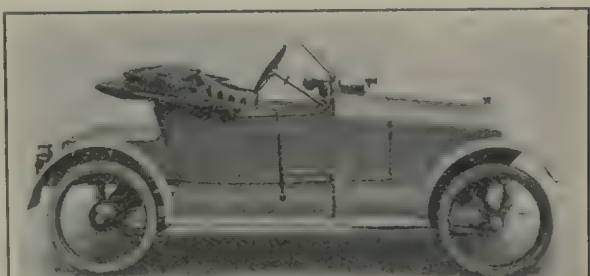


A typical belt driven light car, the D.E.W. This machine has an air cooled V type twin-engine, and a combination chain and belt transmission.

Comparatively few light cars of this type were turned out in the early part of 1913, but towards the middle and end of that year the demand was considerable, and by the date of the 1913 Shows there was quite a little boom in light cars. Continental manufacturers—particularly the French—had also seen the possibilities of this form of motor car, and had many models on the market as well as organising races for this type.

Gradually British motor cycle firms realised that a motor car on motor cycle lines was more or less a dream, and they either dropped this type of machine altogether or turned their attention to a miniature car which, when produced, could not be sold for much under £150, and in many cases commanded a considerably higher price.

Naturally, under the cycle car definition of 1,100 c.c. engines and 6 cwt. chassis, designers were careful to see that their cylinders did not exceed the limits allowed for competition, although, now that the light car definition will probably go up to 1,400 c.c., nearly all the newer designs will have increased c.c. This proves that the 1,100 c.c. capacity limit is too small for the majority of light cars, and that while it remained so restricted the light car industry was being retarded.

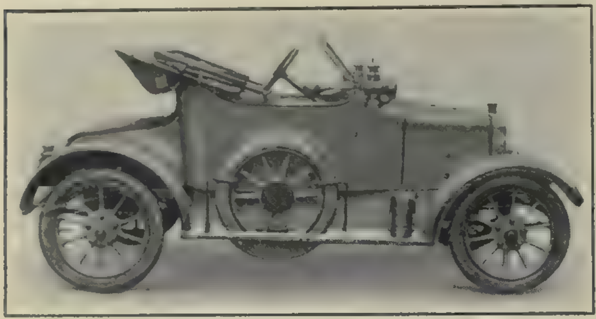


One of the most popular machines on the market is undoubtedly the Humberette, of which a large quantity has been sold. Our illustration is of the water-cooled type.

The design of light cars, cycle cars, and light passenger-carrying machines with engine capacities up to 1,400 c.c. is somewhat varied. In Class I. we have the three-wheelers, with side-by-side seats, and the power conveyed either to the front or to the rear wheel; Class II. is for four-wheelers up to 1,100 c.c., and Class III. for four-wheelers up to between 1,100 and 1,400 c.c.

The first-named generally employ chain transmission, either direct on to front or rear wheel or through a counter-shaft; no well-known type of three-wheeler employs a belt transmission. The machines in the second class employ both V and flat belts, chains, friction wheels and discs, and gear drives, both bevel and worm. Many makers have tried to dispense with a differential, and in so attempting to reduce

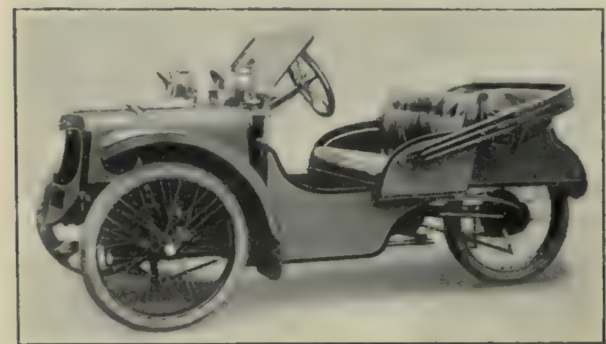
cost of production they have adopted one or other of the following methods: dependence on one wheel to effect the drive; driving both wheels separately by belts, and trusting to the slip of the belt to allow one



The McKenzie is in the class over 1,100 c.c., the dimensions of its engine being 58 × 110 mm. = 1,162 c.c.

wheel to overrun the other when turning corners; driving both road wheels from a central crown wheel, but attaching one wheel to the axle by some form of friction device which allows slip to take place when the car is not travelling in a straight line; or attaching both rear wheels rigidly to the shafts, this implying that one must slip when the car is cornering. The last-named system, theoretically incorrect though it may be, seems to answer well, while tyre wear is not excessive.

Frames show a tendency to come into line with usual car practice and to be made of pressed channel steel, although there are both tubular and armoured wood frames on the market. Tyres vary from 650 mm. × 65 mm. to 700 mm. × 80 and 85 mm. Most of the smaller and lighter types adopt the 650 mm. × 65 mm. tyres, but cars over about 7 cwt. are wisely tyred with the larger sizes. The engines of the light



The twin-cylinder V type Morgan Runabout. All three wheels are sprung and the final transmission is by chain.

car probably show more diversity of type than do those of any other form of self-propelled road vehicle, for the light car industry has gone through all the gamut of motor cycle engine design as well as embracing the car patterns. Thus we have single, twin, and four-cylinder vertical engines on light cars, also V twin and horizontally opposed twin-cylinder engines, both air and water-cooled. No one has yet actually produced a six or eight-cylinder light car engine, but there are rumours of a six-cylinder to be put on the market before long.

In the "Imperial Year Book" of 1913 we wrote: "It cannot be said that the cycle car has yet attained the reliability of a good motor cycle and sidecar," and those words have proved correct, because, excluding tricars, which proved themselves long ago and hardly enter into the light car question at all, since they are made more or less on cycle lines, there are practically no true cycle cars in existence to-day. They are nearly all light cars, and the best of them are models in miniature of larger motor cars whose makers, after years of dearly bought experience, have evolved the modern motor car. In last year's "Imperial Year Book" we wrote: "1913 is seeing many reformations in the design of cycle cars"; 1914 will see still more.

Condensed Specifications of Some Typical Cycle Cars and Light Cars.

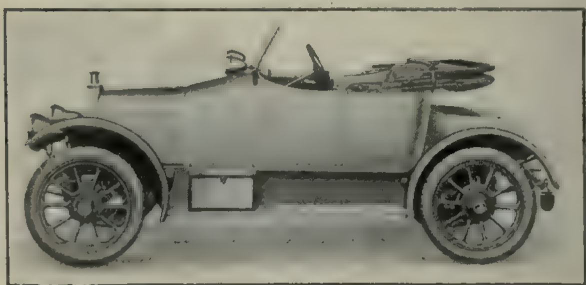
8 H.P. MORGAN.—V, two cylinders, 85 × 85 mm. = 964 c.c., air-cooled, two speeds, chain drive, three fixed wheels, 650 × 65 mm., wire spokes, 6ft. wheelbase, 4ft. track, weight complete 308 lbs. price £89 15s.

8 H.P. D.E.W.—V, two cylinders, 85 × 85 mm. = 964 c.c., air-cooled, two speeds, combination chain and belt drive, 7ft. wheelbase, 3ft. 6½in. track, four fixed wheels, 650 × 65 mm., wire spokes, weight of chassis 5½ cwt. Price £95.

The latest Enfield Autolette has a four-cylinder vertical engine, three speeds, and gear transmission.

8 H.P. HUMBERETTE.—V, two cylinders, 50°, 84 × 90 mm. = 998 c.c., air or water-cooled, three speeds, shaft drive (bevel), differential back axle, four fixed wheels, 650 × 65 mm., wire spokes, 7ft. 5in. wheelbase, 3ft. 6in. track, weight of chassis 6 cwt. Price, water-cooled £135.

7 H.P. SWIFT.—Vertical, two cylinders, 75 × 110 mm. = 972 c.c., water-cooled, three speeds, shaft drive (bevel), differential back axle, four fixed wheels, 700 × 80 mm., wire spokes. Price £140.

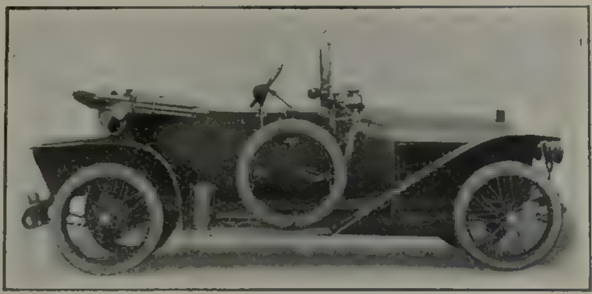


Another very complete light car, the 10 h.p. Singer. Not only has this machine shown itself to be successful in competitions on road and track, but it is eagerly sought after by tourists.

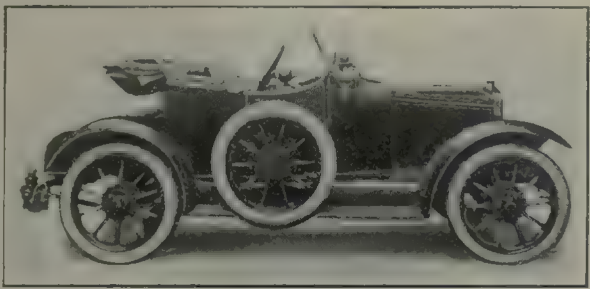
PERRY.—Vertical, two cylinders, 72 × 108 mm. = 879 c.c., water-cooled, three speeds, shaft drive (bevel), differential back axle, 7ft. wheelbase, 3ft. 8in. track, four detachable steel wheels, 700 × 80 mm. Price £127

Condensed Specifications of Some Typical Light Cars (*continued*)

9 H.P. ENFIELD AUTOLETTE.—Vertical, four cylinders, 59 x 100 mm. = 1,094 c.c., water-cooled, three speeds, shaft drive (worm), differential back axle, four fixed wheels, 700 x 80 mm., wire spokes, 7ft. 9in. wheelbase, 4ft. track. Price £158.



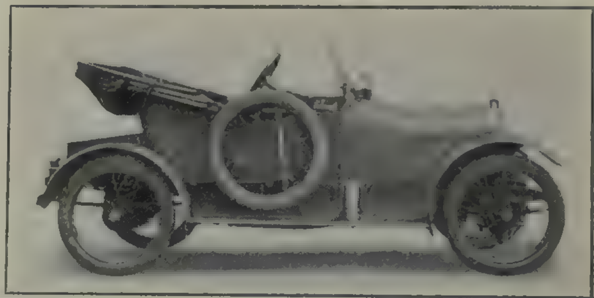
A typical French light car, the Licorne; the engine c.c. is 1,244.



Made by one of the largest firms in the Midlands, the Perry twin-cylinder light car.

9.5 H.P. STANDARD.—Vertical, four cylinders, 62 x 90 mm. = 1,088 c.c., water-cooled, three speeds, shaft drive (worm), differential back axle, four detachable wheels, 700 x 80 mm., wood or steel spokes, 7ft. 6in. wheelbase, 4ft. track. Price, with hood, five lamps, and spare wheel, £195. Chassis price £175.

10 H.P. SINGER.—Vertical, four cylinders, 63 x 88 mm., water-cooled, three speeds, shaft drive (bevel), differential back axle, four detachable wheels (steel), 700 x 80 mm., 7ft. 6in. wheelbase, 3ft. 6in. track. Price, as illustrated on previous page, £195, including lamps, spare wheel, hood, and screen. A dynamo electric lighting outfit is supplied with this car at an extra cost of £9 15s.

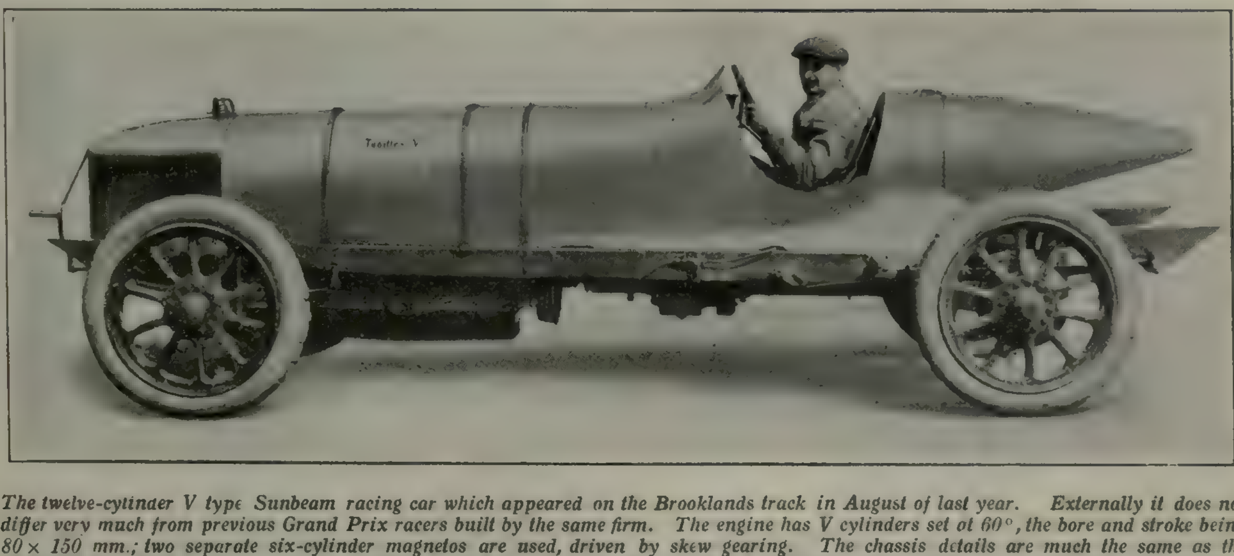


The Swift is one of the best known of the twin-cylinder vertical water-cooled machines which comes within the A.C.U. and R.A.C. definition of 1,100 c.c. It is bevel gear driven.

McKENZIE.—Vertical, four cylinders, 58 x 110 mm. = 1,162 c.c., water-cooled, three speeds, shaft drive (worm), differential back axle, 8ft. 6in. wheelbase, 4ft. track, five detachable wheels, 700 x 80 mm. Price, with five lamps, spare wheel, hood, and screen, £175.

10 H.P. LICORNE.—Vertical, four cylinders, 60 x 110 mm. = 1,244 c.c., water-cooled, three speeds, shaft drive, differential back axle, 8ft. 2½in. wheelbase, 4ft. 1½in. track, four fixed wheels, wire spokes. Price £199 10s.

The Twelve-cylinder V Type Sunbeam Racer.



The twelve-cylinder V type Sunbeam racing car which appeared on the Brooklands track in August of last year. Externally it does not differ very much from previous Grand Prix racers built by the same firm. The engine has V cylinders set at 60°, the bore and stroke being 80 x 150 mm.; two separate six-cylinder magnetos are used, driven by skew gearing. The chassis details are much the same as the standard six-cylinder Sunbeam, and no differential is employed. The wheels and tyres are 880 x 120 mm. and the top speed ratio is 2 to 1, so that the engine revolutions at 100 miles per hour are in the neighbourhood of 2,000. The wheelbase is 10ft. 6in., and to keep the rear axle down the last two feet of the frame are filled with lead, and the petrol tank in the tail also assists in this direction.

Vulcanising Tyres in the Garage and on the Road.

With Particular Reference to the H.F. "New Baby" Vulcaniser.

THE super-excellence of the average present-day car, and its consequent low cost for running and repairs, throws into prominence the disquieting fact that nowadays tyre costs comprise the bulk of the disbursements recorded in the running costs book. In no connection does the "stitch in time" proverb bear more weight than in the matter of tyre repair, for damage to a tyre, however slight, if neglected, will seal the doom of that tyre rather sooner than later, as in some mysterious manner the rate of spread of damage in a tyre seems progressive, so rapid and insidious does disintegration occur.

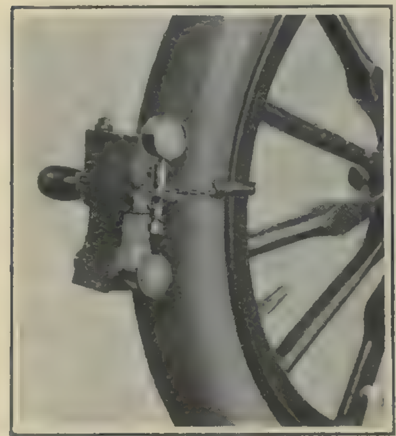


Fig. 1.—The "New Baby" in position for vulcanising a cut on the tread.

Of course, we do not wish to infer that the Harvey Frost instruments — with which we propose to deal — are intended only for dealing with trivial blemishes, because the smallest model is capable of doing quite useful work and the larger garage sizes are capable of tackling the heaviest repairs, but what is desired to impress is that much heavy and expensive repair work on tyres can be saved if cuts, punctures, and bursts are tackled as early as possible with one of the smaller vulcanisers.

In these days of spare wheels and detachable rims a tyre puncture is not such a serious affair as it was originally, for the changing of a wheel or rim is a matter occupying a few minutes only, even under the most adverse conditions. At some time or other, however, the punctured inner tube or the damaged outer cover must be repaired, and, although the facilities for repairing punctures by means of externally applied patches have considerably improved within recent years by the introduction of the Parafaced patch, vulcanisation still remains the more satisfactory method.

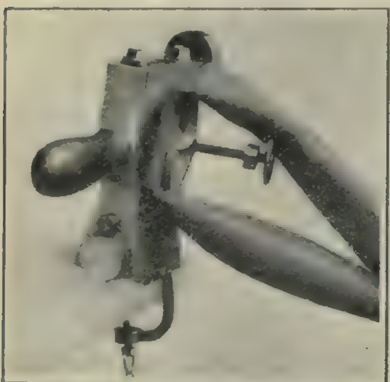


Fig. 2.—Vulcanising a damaged tube Note the insulated handle for lifting the hot machine.

Of tyre vulcanisers specially designed and made for the private owner's use, the H.F. was probably the first introduced into England, and of recent years none of the numerous models has been more appreciated by car owners than the "Baby," which is to be superseded by the "New Baby." This is a small edition of the "Car" type, which was the model first introduced for carrying on the car, and like all the four H.F. portable models is self-contained as regards its source of heat. It is, however, with the "New Baby" vulcaniser that we purpose dealing. The external appearance of this apparatus is apparent in figs. 1 and 2. Its weight is just over 4 lbs., and its dimensions 6½in. x 5in. x 2½in. Fully to describe all the special features of this device, together with its accessories, would occupy too much space, but briefly it may be said to consist of a gunmetal boiler with a self-contained methylated spirit burner. Secured to a bench or to the running board of a car, or otherwise as will be mentioned later, the water within the boiler can be quickly brought to boiling point by means of the spirit lamp, and the heat required for vulcanising a repair is then available. In the course of repairing a punctured or burst inner tube, for instance, the actual vulcaniser is not immediately required. The various processes through which the repair goes are shown in fig. 4, where to the left of the section of inner tube will be seen a gash extending almost half the width of the flattened tube. In general the method of repair—which is the same whether a pinhole puncture or a six inch gash is to be tackled—consists of somewhat enlarging the cut by bevelling its edges and filling up the hole so formed with a plastic rubber compound, which, when subjected to a certain heat for a certain length of time, becomes what is termed vulcanised. It then equals, if it does not exceed, in strength and elasticity the rubber of which the tube is formed.

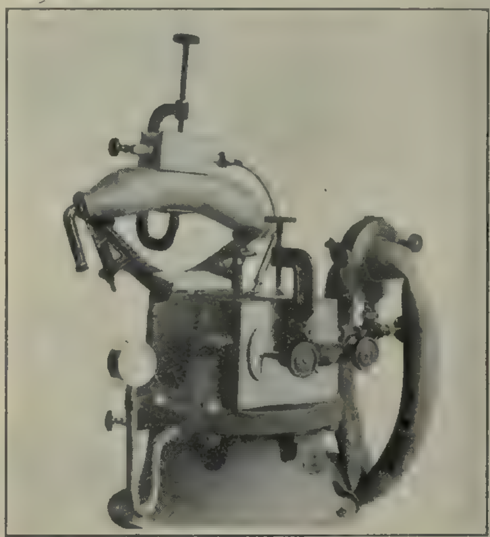


Fig. 3. -Showing tube in position for vulcanising butt joint.

Referring again, therefore, to fig. 4, we have at A the original gash or burst. At B the same defect is seen with the edges bevelled. At C the hole is seen after it has been roughened by means of a rasp. Before the hole is filled with H.F. Plastene two coats of a special flux are given. This flux ensures the successful amalgamation of the subsequent filling of

Plastene with the rubber of the inner tube. At E is seen the plastic compound roughly filled into the hole previously treated as described. Before, however, it

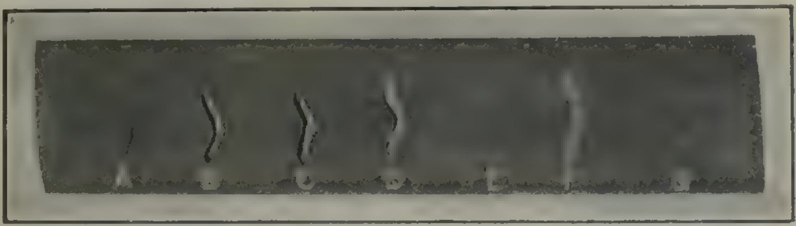
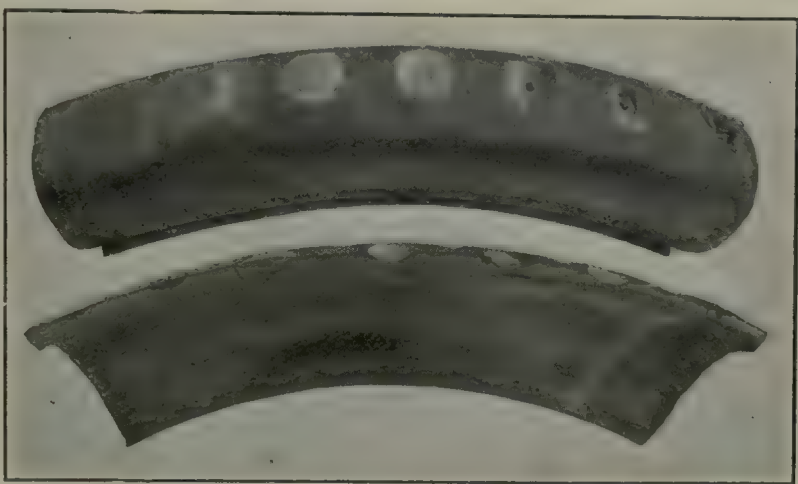


Fig. 4.—Seven views of a burst in an inner tube, repaired by the aid of the "Baby" vulcaniser. A is the untouched burst, and at G the finished repair, the various stages being shown between.

is submitted to vulcanisation the compound is carefully shaved off flush with the surrounding rubber as shown at F.

The repair is then ready for vulcanising, and the tube at this point is then secured against the side of the vulcaniser by means of a screw pad. The actual vulcanising occupies from eight to ten minutes, depending upon the *thickness* of the air tube, and not upon the width or length of the repair. A very little practice upon old discarded air tubes gives the novice a knowledge of the length of time necessary.

Referring once more to fig. 4, the vulcanised repair is almost invisible, but actually it occurs above the letter G. The "New Baby" vulcaniser will repair air tubes with a burst up to 4in. in length by 2in. wide in one operation, but in the event of a larger repair than this being necessary, by reason of a burst of unusual dimensions, it can be accomplished in two or more operations by submitting a portion of the repair at a time to the vulcanising process, slight overlapping being immaterial, but care should be taken not to get the doubly "cooked" section too overdone.



Figs. 5 and 6.—Two views of a cover repair. The repair in each case is shown in seven stages.

Of even greater value than the repair of air tubes, however, is the application of the "New Baby" vulcaniser to cuts up to 2½in. × 1½in. in outer covers, as by its timely application much mileage may be saved to the cover. The processes of repair are exactly the same as in an air tube, and we have endeavoured to indicate these processes in the photographs reproduced as figs. 5 and 6, the latter being a section of a cover in which a hole has been repaired by this method. In repairing outer covers, the vulcaniser is secured to the tyre by means of an adjustable chain supplied for the purpose. It is desirable that an outer cover should be repaired whilst it is in position on a car wheel or rim, in order that it shall be maintained in its normal running shape (see fig. 1). Special aluminium plates or pads are supplied with the outfit shaped to fit the curved tread of the tyre, so that the heated surface is in close and actual contact with the surface under repair.

The repair of tubes and covers, to the extent mentioned by this method, can be accomplished by any individual of average intelligence.

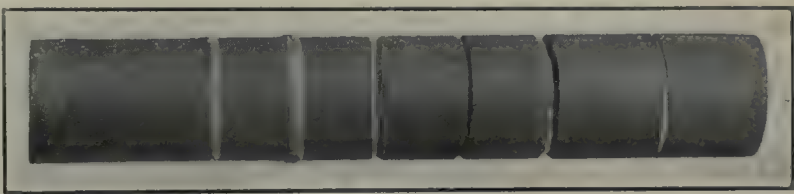


Fig. 7.—The seven stages of making a butted joint.

From what has been said above, it is clear that the convenience of carrying one of these small vulcanisers on the car when on a long tour through sparsely populated country is too obvious for further remark.

It is not to be expected that such a small apparatus will cope with such work as vulcanising joints and valve seatings and repairing fabric bursts, but as illustrating one of the repairs within the capabilities of the larger Harvey Frost machines, such as used by garage proprietors, etc., we reproduce photograph fig. 7. This shows the H.F. method of forming a join in a tube. The two ends of the tube are butted together, as shown in the illustration; the two ends are then bevelled off with scissors, roughened with a rasp, treated with flux, and the space between them filled with Plastene compound, and the join vulcanised in a special expanding mandrel, which causes the join to assume its tubular shape whilst submitted externally to pressure from a steam-heated vulcanising mould.

In the case of valve seating where a puncture has occurred near by, the valve stem is removed, and the hole sealed up in the usual way after removing the tabs. A fresh place is then chosen for the valve stem, and the extra thickness of rubber built up round it, and the whole vulcanised in position, making a mass of solid homogeneous rubber for the valve stem seating, which does not have to be stretched or strained to seat the valve stem.

The Eight-cylinder V Engine.

The Why and Wherefore of its Advantages over Other Types. By W. G. Aston.

EVERYONE will remember what a tremendous volume of ink was spread over the subject when the six-cylinder engine first came amongst us, and definitely marked an epoch, or perhaps in the interests of strict accuracy it would be better to say not when it first came amongst us, but when its coming was first noised abroad. Now there are good grounds for supposing that another such epoch will be marked in the comparatively near future by the eight-cylinder engine, which is even more superior to the six-cylinder than the six-cylinder is to the four-cylinder. So far as motor cars are concerned, it is only employed by one firm, *i.e.*, Messrs. De Dion Bouton, but it requires no prophet to see that this principle is speedily gaining adherents, and to foresee that it will continue to do so.

It is quite evident that in practice the eight-cylinder engine commands the approval of the public, and it likewise makes a strong appeal to those motor manufacturers who have taken the trouble to look carefully into this very interesting subject. For some extraordinary reason, however, it is quite apparent that a great deal of misconception exists as to the why and wherefore of the eight-cylinder engine.

When the four-cylinder was standard and the six-cylinder engine came along, the latter represented a very simple proposition. There were two more cylinders, and consequently it was quite easy to see that somewhere or other in the cycle of operations the crankshaft received two more impulses. With the De Dion eight-cylinder engine the case is rather different, because here the cylinders are set at an angle with one another, and not all in a row along the crank chamber. The engine thus presents the appearance of two separate four-cylinder engines, and very widely the conclusion has been jumped to that these two four-cylinder engines working together are practically just twice as powerful as one four-cylinder engine, and that beyond that there is nothing more that remains to be said.

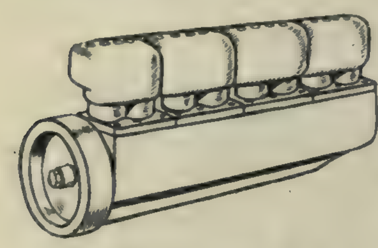


Fig. 1.—An eight-cylinder all-in-line engine.

Of course, the eight-cylinder engine is nothing particularly new; in the aeronautical world, it is quite an "old stager," as some of the earliest aeroplane motors were of this type, such as the Antoinette, the E.N.V., the Wolseley, the J.A.P., etc. The general public has, however, never taken much interest in these engines, and consequently never bothered its head about them. If it had done so it would ere now have expressed a strong desire to possess this type.

The object of the present article is to point out the great advantages of the eight-cylinder system. Although Messrs. De Dion Bouton are undoubtedly the first to produce a modern eight-cylinder chassis as a commercial proposition intended for public consumption, they were not the first to employ an eight-cylinder in an automobile by any means; as long ago as 1902 Charron, Girardot and Voigt produced an experimental car with eight cylinders all-in-line, and a similar engine was used by the Weigel Co. in the Grand Prix Race of 1907. There was also the famous Rolls-Royce "Legalimit" eight-cylinder V engined car of 1905.

The V type of engine and the all-in-line type are diagrammatically illustrated in figs. 1 and 2. In some respects they are similar, in others they are totally different. As a case in point, the all in line engine has not a ghost of a chance of coming into favour, whereas the V type may be regarded as a fair certainty for the future. Why this should be so is clear enough. The former is of enormous length, and since the wheelbase of a car intended for ordinary use is limited to a certain definite length, the body space of the vehicle would have to be very restricted for the chassis to accommodate an all-in line type eight cylinder engine. Then, again, it is very much heavier than the V type, because it has twice as large a crank chamber and twice as long a crankshaft. The last-named must therefore be made exceedingly strong, so that weight in this part goes up disproportionately. As far as balance and torque are concerned, both engines are identical, in each case the balance is perfect, for there are no unbalanced forces whatever; whilst in each case the crankshaft receives four impulses per revolution.

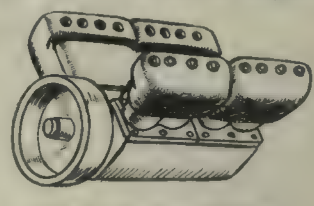


Fig. 2.—An eight-cylinder V-type engine.

Fig. 3 shows diagrammatically an all-in-line eight-cylinder crankshaft, with a bearing between each throw. It will be perceived that it consists simply of two four-cylinder crankshafts placed in tandem, the one having its webs at an angle of 90° to the other. In the V engine, instead of using, as it were, a second crankshaft, the second four cylinders are applied to the first crankshaft, but are themselves arranged at 90° to the first set of cylinders.

The advantages of this system will be discussed in detail later on. For the moment we will content ourselves with making clear the value of the eight cylinders from the *torque* point of view. In order to do this, let us imagine that the V engine is tipped

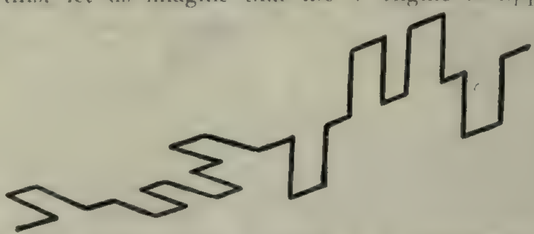


Fig. 3.—Diagram of the crankshaft of an eight-cylinder all-in-line engine.

over on to its side, as shown in the diagram fig. 4. Now let us first consider the behaviour of the four vertical cylinders, which are, in point of fact, just an ordinary motor car engine. The crankshaft having its throws at 180°, the impulses are received at equal intervals, which intervals may be easily remembered by considering the crankshaft as the hour hand of a clock, and the first revolution of the flywheel as a.m. and the second as p.m. The crankshaft receives its

impulses, in these circumstances, from the four vertical cylinders at 12 a.m., 6 p.m., 12 p.m., and 6 a.m.; in other words, the intervals between the impulses are half a revolution of the crankshaft. Now let us consider the horizontal group of cylinders, the crank chamber still being imagined to be marked in the same way as the clock face. These cylinders give their explosive impulses at 3 p.m., 9 p.m., 3 a.m.; and 9 a.m., the intervals again being half revolutions of the crank chamber. It will thus be seen that no two explosions actually occur at the same time, but that they all follow one another at equal intervals of a quarter of a revolution. The turning effect, or torque, of the eight-cylinder engine is, therefore, twice as good as that of the four-cylinder engine.

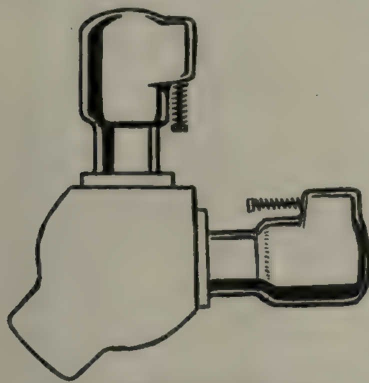


Fig. 4.—Front view of the eight-cylinder V engine with one set of cylinders vertical.

By applying the same method to the six-cylinder engine, it will be perceived that the three impulses which are received by the crankshaft per revolution occur at twelve o'clock, four o'clock, and eight o'clock, so that the eight-cylinder is superior to the six-cylinder in torque by a matter of 33%.

Since in the four-cylinder engine one pair of pistons is at the top and one at the bottom of the stroke, there can be no overlapping of impulses, because the explosion pressure cannot last longer than from twelve o'clock to six (*sic*), though, as a matter of fact, it never does so actually, as the exhaust valve is always allowed to open slightly before the end of the power stroke. For the purpose of the present argument, let it be assumed (and there is no particular inaccuracy in this) that the explosion pressure lasts, as it were,

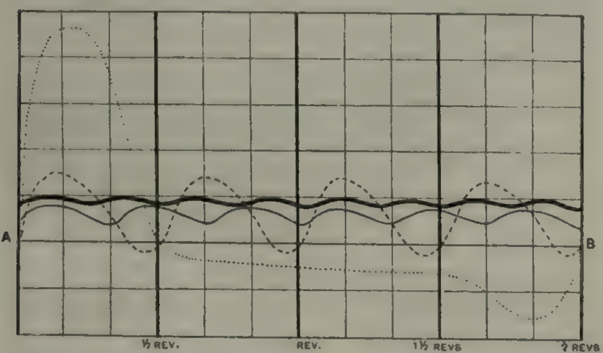


Fig. 5.—Diagram showing the relative torque curves, during two revolutions, of engines with one, four, six, and eight cylinders. The dotted line shows the single cylinder, the broken line a four-cylinder, the thin continuous line represents a six-cylinder, and the heavy line an eight-cylinder.

from twelve o'clock till five o'clock. In the six-cylinder engine it will then be seen that the explosions overlap by one hour, that is to say, that when the second cylinder fires its charge at four o'clock, the first cylinder has still got one hour to go. It is this fact which, more than anything else, has brought the six-cylinder to the prominence it now enjoys. In the eight-cylinder matters are better still, because when any explosion occurs the previous one has still *two* hours to go, and this means that the tangential pressure on the crankshaft, which causes it to revolve against the load, is always strongly positive; that is to say, at every point in its revolution the crankshaft is receiving an impulse. In the four-cylinder engine periods occur at which the flywheel has to do negative work; that is to say, there is no appreciable positive pressure at any of the pistons.

Fig. 5 shows all this graphically, although it does not pretend to absolute accuracy. Four curves or torque diagrams are given. The first, which is shown by the dotted line, represents the torque of a single-cylinder engine. The base line A B is divided into four equal distances, which each represent half a revolution of the engine. When the curve is above this line it shows that the crankshaft is receiving a power impulse. When the curve is below the line it shows that at this point a certain amount of work has to be given back by the flywheel. The second curve, which is shown in broken lines, is the torque diagram of a four-cylinder engine, in which it will be seen there are short periods of negative work occurring. That of a six-cylinder engine is shown in the thin unbroken line, which, it will be observed, lies wholly above the base line A B, indicating that there is always a power impulse upon the crankshaft. The thick black line is the curve of the eight-cylinder engine, which is higher still above the base line, because the minimum positive pressure existing at any time in the engine is always higher than in the six-cylinder.

The ideal engine would give a torque diagram which would represent a perfectly straight line. Generally speaking, the torque curve of the eight-cylinder does not fall very far short of this, as the amplitude of its waves is short, and the difference between the maximum and minimum tangential pressures is also very small.

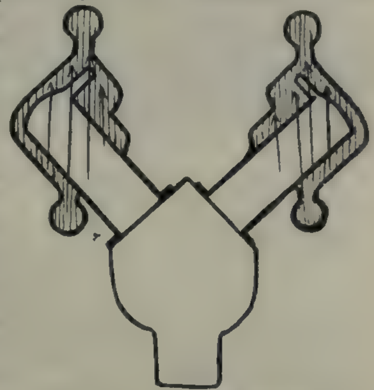


Fig. 6.—Diagram showing the natural water circulation tendency in a V-type engine.

It may now be asked why not continue to multiply cylinders and gain an even better result? The answer to this is very simple. Eight cylinders are only two more than six, and the improvements which they produce are very marked. Now the next size of engine would be twelve-cylinder, or half again as many cylinders, which would not possibly give 50% better result, and so on. A glance at the torque curves of fig. 5 will show that as the cylinders are increased the difference in the characteristics of the curves tends to become less marked. Drawn to the same scale, the curves of a sixteen-cylinder engine would hardly be distinguishable from the twelve, and twelve scarcely distinguishable from those of the eight. For ordinary purposes, therefore, the eight may be considered to be the ideal as well as the practical maximum, for motor car work at all events.

Just as in the old days, and even at the present time, one always described the excellence of the six-cylinder engine by comparing it with the four-cylinder, so we

The Eight-cylinder V Engine.

will now discuss the eight in terms of the six, over which it has several very pronounced advantages.

1. SIZE.—In length, which is the only dimension that matters, within reasonable limits, on a motor car, the eight-cylinder is preferable to the six, by a matter

A 30 h.p. six-cylinder Napier undergoing a severe test in the Austrian Alps, under R.A.C. official observation. This test took place in September, 1913. The car climbed the following Alpine passes during the trial: Mont Cenis, Pordoi, Falzarego, and Simplon. The complete ascent of the Simplon could not be undertaken owing to an avalanche having swept away a portion of the road. The distance covered was 2,106½ miles, and only one mechanical adjustment was made, and this of so trivial a nature that it only occupied 2m. 8s. to rectify. The following particulars of the car appeared on the R.A.C. certificate of performance: Bore and stroke 89 × 127 mm., running weight 45½ cwts., top gear ratio 4·1 to 1, size of tyres 895 × 135 mm. Fuel consumption 18·09 m.p.g. or 41·08 ton miles per gallon. The same car was driven to Brooklands after the road test, and accomplished a flying half mile at the rate of 62·61 miles an hour.

of 30%. The space available for bodywork upon the chassis is, therefore, much greater, and this in itself is a point of enormous importance. But of even more value still are the advantages which follow on the use of a short engine. The crankshaft has all its throws in one plane, and is therefore cheaper to manufacture than the crankshaft of a six-cylinder engine, the throws of which lie in three planes, as each pair is at an angle of 120° to the others. Again, the crankshaft being shorter possesses less torsional elasticity; therefore periodic vibration, which is so bad a characteristic of six-cylinder engines, unless special preventive measures are taken, is greatly reduced. In like manner the camshaft is shorter, and periodic vibrations arising from this source are also reduced. No great length of inlet piping is required, as is the case with the six, as the four V form cylinders lend themselves very readily to a piping arrangement which gives each cylinder practically an equal chance of getting a full charge of gas—that is to say, no cylinders are likely to be starved.

2. WEIGHT.—Power for power, and allowing equal strength of material, the eight-cylinder engine is lighter than the six, owing to the shorter crank case, lighter crankshaft, lighter flywheel, shorter camshaft, and lighter reciprocating parts (the cylinders being smaller), and this again is a great advantage.

3. TORQUE.—The eight-cylinder has a 33⅓% better torque than the six, as previously described.

4. BALANCE.—Theoretically, both engines are equal in this respect—that is to say, both are perfect. But periodic crankshaft vibration is far more likely to occur in the six than in the eight-cylinder. In the former it can only be prevented by special balancing, or by the use of a very strong crankshaft.

5. COOLING.—The eight-cylinder is preferable to the six, as each row of cylinders can be treated as a separate unit, and if the valve chambers face one another (as in the diagram fig. 6) it will be seen that the water circulation has no tendency to form "pockets" round the valves. Each engine unit being smaller, a thermo-syphon system of circulation can be used without requiring the radiator to be placed very high above the engine. In other words, if the inclination of the water outlet from the head of the cylinders is to be the same in each case, the six-cylinder engine requires the radiator more than half as high again above it as the eight.

6. LUBRICATION.—Shorter oil passages and a smaller length of crankshaft are advantages in this respect, but the V type eight-cylinder has the disadvantage that if the pistons be lubricated by splash, one set of the cylinders is apt to get more oil than the other set. Thus, if the crankshaft revolve clockwise, the left-hand block of cylinders tends to get over-lubricated and the right-hand block under-lubricated. This difficulty can, however, be overcome.

7. IGNITION.—There is nothing to choose between the two types, as both require one magneto which differs only in the gear ratio between it and the camshaft, and, of course, in the number of contacts on the high tension distributer.

The honour of being the first man to accomplish over 100 miles in the hour stands to the credit of the late Mr. Percy Lambert, who drove the 25 h.p. racing Talbot depicted above, a distance of 103 miles 1,470 yards in one hour on the Brooklands track on February 15th, 1913. Incidentally Mr. Lambert broke the world's record for 50 and 100 miles with standing start, as well as establishing the above marvellous distance for a motor car with a comparatively small engine, 101·5 × 140 mm. Unfortunately the hero of this record was killed at Brooklands in November last year while making an attempt to beat the Sunbeam hour record of 107 miles 1672 yards.

8. ACCESSIBILITY.—Under this head the six-cylinder scores so far as the valves are concerned.

In brief, the great advantages of the eight-cylinder engine are its small size, light weight, excellent torque, perfect balance, and good carburation, in all of which points it is equalled by no other type of engine at present applied to motor car propulsion.

Lubricating Systems

A Review of Existing Methods of Maintaining the Oil Feed to the Engine Bearings

THE engine, it is obvious enough, is the heart of an automobile, and it is no less true that the heart of the engine is its lubrication system. The ignition may fail and cause a temporary stoppage. The carburation may be upset by some extraneous cause and produce a loss in efficiency. But if the lubrication go wrong not only will there be a loss in efficiency terminating in a stoppage altogether, but it is more than likely that serious damage will be done to vital parts. This being the case, it is somewhat surprising to find ***(tot homines, quot sententiæ)*** that there are almost as many varieties of lubricating systems as there are designers of motor cars. They, however, lend themselves to grouping readily under a few main classifications, though they differ from one another in a great many minor and sometimes important details. As set out hereafter, these classifications are primarily three in number, the completely positive system, the partially positive, and what may be described as the "incidental." In other words, there is the system in which the oil is directly forced to every moving part, secondly the system in which it is forced to some moving parts and splashed on to others, and thirdly the system in which the oil is splashed on to all parts.

On *prima facie* grounds one is justified in saying that only the first of these systems is, practically speaking, applicable to the ideal car, but automobile design, like every other branch of engineering, is built up out of an infinite number of compromises, and hence there may be some difference between what is theoretically perfect and what is practically expedient. One of the chief difficulties of motor car construction is to arrange matters so that economy is served no less than efficiency. The loose tongued often make these two terms interchangeable, being led away by appearances, but as a matter of fact they are extremely distinct. Indeed, it is almost a truism to say that efficiency can always be improved at the expense of economy, provided that the latter term be made, as it should be, to embrace a consideration of the whole and not merely of a part. Automobile economy is, it must be remembered, something more than mere fuel consumption. To take a case in point. Where a factory is driven by a steam plant, efficiency of this plant (in terms of horse-power developed per unit weight of fuel) may be increased by the use of some special form of device which regains part of the heat which is otherwise wasted up the chimney. But if this device cost £1,000 to install and only saves five tons of coal a year, then it is clear that it regains less than it loses, and is, therefore, not economical, though it is none the less efficient.

It is exactly the same with lubricating systems. Of two lubricating systems, of which A costs £30 to install and uses one gallon of oil per thousand miles, whilst B costs £15 to install and uses a gallon and a quarter of oil per thousand miles, it is obvious that A is the more efficient, while B is the more economical always provided that both work in practice sufficiently well to allow the engine a life commensurate with that of other parts of the car.

The probability is that if a car's useful life were expected to be, say, a hundred years, there would be no division amongst designers' opinion as to which was the more desirable principle of lubrication to adopt. As it is, other important questions enter into the matter. Simplicity, and Ease and Cheapness of Accurate Production, and Understandableness, are points which are driven home by competition in the open market, and hence it is only natural to find these considerations modifying the theoretical idea of perfection. It is not intended to be suggested by this that any reputable motor car manufacturer would deliberately sacrifice either efficiency or economy to decrease his cost of production. On the other hand, the difference between "Perfection" and "Nearly Perfection," whilst being obvious enough on a balance sheet, may never make its presence felt in a car's actual running. This, then, is the fundamental compromise which lies at the root of car design.

The pros and cons of the two main systems are as follows, the intermediate system, which is partially mechanical and partially splash, partaking to a certain extent of their advantages and disadvantages.

Positive System.

The great advantage is that, provided there be a sufficient pressure behind the oil supply, lubrication will be forced to every working part. It might be thought that one difficulty in design contained in this system would be the proportioning of the various oil orifices which lead to the cylinder walls, gudgeon pins, big end bearings, and main crankshaft journals. This, however, is not the case, it only being necessary to make certain that the piston, which is, as it were, the terminus of the line, is receiving a definite amount of lubricant, when the other bearings can be flooded to a considerable extent without doing any harm. There is, however, a limit to this flooding, for a good proportion of the excess flowing from the big end bearings will be flung on to the cylinder walls and the latter consequently over-oiled. The principal difficulty is that the crankshaft must be hollow practically throughout its length, and that to provide a sufficiently easy flow the internal leads must be of fairly large diameter. Great care must also be taken in plugging the ends of these ducts on the crankshaft webs that the weight of the plugs is uniform, otherwise the crankshaft is slightly thrown out of balance. The certainty with which the oil is forced along the crankshaft and up the connecting rod to the gudgeon pin and piston depends to a considerable extent upon the tightness of the big end and main bearings. If these become slack then the feed to the gudgeon pin is lessened by the amount that they allow to leak past, hence wear in a big end bearing may, with this system, reduce

beyond the safety limit the amount of oil delivered to the piston. In fact, as the system is usually arranged, the presence of one slack main bearing can affect the wear of all the other bearings unless due notice be taken of it and the feed pressure increased. Providing this be high enough an oil film between the surfaces can practically be ensured under all conditions of load, and it is for this reason that when properly carried out the positive principle is capable of giving such excellent results. It cannot be denied, however, that it is expensive to install, and a considerable amount of work has to be done on parts which require to be accurately balanced.

Splash System.

The splash system is, of course, simplicity itself, and by requiring a minimum amount of internal piping and no internal work to be done whatever upon balanced rotating parts this is naturally the system which makes best for cheap and rapid production. It has also been abundantly proved that when intelligently designed it gives remarkably good results. Its disadvantages are primarily that the flow to the bearings being by gravity the oil film between working surfaces is liable to be destroyed under heavy loads. This difficulty can, of course, be overcome almost completely by the use of properly designed distributing ducts in the bearings. A secondary disadvantage arising out of the first is that if a particle of foreign matter be accidentally allowed to enter the oil circulation it may seriously affect its working, whereas with a sufficiency of pressure behind it such matter would, of course, be blown out of the way, hence in a great many cases this splash system is modified by a positive feed through the main bearings and big ends, as these parts are the most easily damaged by a cessation of the supply of lubricant.

One disadvantage of the splash system is that oil is not flung uniformly on to the cylinder walls, but in fact is distributed in what is the direct converse of the desired manner. If the engine run clockwise more oil is thrown by the connecting rod on to the right hand cylinder wall than on to the left, the latter being, of course, nearly tangential to the path of the big end. It is, however, this left hand wall which resists the thrust of the piston due to the angularity of the connecting rod, and hence the oil is not directed to that side of the piston and cylinder which is under the greatest load. Much the same may, however, be said of the positive system if the oil be fed to the cylinder walls simply through the hollow gudgeon pin, for in this case, too, the oil is led to the slack side instead of the tight side. It has sometimes been stated that this is correct in principle, being exactly analogous to the case of the journal bearing in which as every apprentice knows, lubrication must be fed in at the slack side. Such an analogy is, however, quite erroneous, since the piston does not rotate, and hence has no tendency in itself to maintain an unbroken oil film around it.

Feed.

There are at present three systems of feed in use, namely:

1. Feed by time. (This at one time enjoyed considerable popularity, but is now only found on the cheapest of cars.)
2. Feed relative to the speed of the engine. (This principle greatly preponderates at the present time.)
3. Feed proportional to the load. (This has only comparatively recently been introduced, and is at present in a very small minority.)

There can be no two opinions as to which of these three is the best. Whilst the last one is right, the other two are almost equally wrong. Feed by time generally takes the form of a visible drip actuated either by low exhaust pressure or by gravity. If the feed be adjusted to give a definite number of drops per minute, then the lubrication remains the same whether the engine ticks round idly or runs at full throttle under load. The feed of oil is thus alternately insufficient and excessive according to the nature of the load against which the engine has to pull. The average load will, of course, under ordinary running remain fairly constant, and hence, in the end, such a feed will come out more or less right. But, on the other hand, it is never *actually* right except at such moments as the engine is running under some specific load. For all other loads it must invariably be wrong.

Much the same remarks apply to the second system, in which a pump is used driven by the engine, and accordingly delivering a volume of oil which varies per unit of time with the engine speed. At the same time it possesses an enormous advantage over the drip feed in that the oil is subject to a practicable pressure. None the less, it fails to an exactly equal extent in giving alternately too much and too little oil according to circumstances.

Let it be supposed that the oil delivered is exactly correct when the car is running at twenty miles an hour on a perfectly level road, then it is obvious that the oil supply will be increased when the car is running down a gradient at thirty miles an hour, and that if no change in gear be made the supply in lubrication will be decreased when it is running fifteen miles an hour up a gradient. This, of course, is exactly the reverse of what should be the case, because at thirty miles an hour downhill the engine would probably be working under a much lighter load than when it is pulling the car fifteen miles an hour uphill, hence at this thirty miles an hour it will require less oil than at the slower speed uphill. In other words, the feed proportionate to engine speed would only be correct provided that the load also was always proportional to the engine speed, whereas, of course, such is not the case under ordinary running, although in the end the two features will probably average out tolerably equal. It is this fact which causes most engines to smoke.

On a slightly down gradient or on the level with the wind behind one, a mere whiff of gas will maintain a car at a fairly high speed, and in these circumstances the engine load is exceedingly light whilst the supply of oil is comparatively heavy. The cylinder walls, therefore, get over-lubricated, with the result that smoking occurs. These several disadvantages are all obviated by making an oil feed proportionate neither to time nor to speed, but to load. This can be done in several ways, three of which are detailed hereafter, viz., the Rolls-Royce, Daimler, and Panhard. In every case the mechanism necessary is extremely simple.

Types of Pump.

Opinions of designers appear to be fairly equally divided as to which is the better type of pump to use for maintaining the oil circulation. At present a gear pump with two pinions running in mesh with one another appears to preponderate, though a direct-acting or plunger pump is apparently increasing in vogue. This certainly is due to the fact that the advantages of a high pressure system are becoming more and more realised, and for this the piston type of pump is superior to the pinion type, as the latter can only pump against comparatively low pressures, and in addition it cannot lift to such an extent as the

plunger type. Both, however, suffer to different extents from the same disadvantages, namely, that unless submerged in the oil supply they require priming before they will work satisfactorily, the piston pump being admittedly better than its rival in this respect. For this reason, one frequently finds them located at the lowest part of the engine, where, provided there be any oil at all in the sump, they are sure to be "drowned," although it by no means follows that this is the most convenient place they could occupy.

Filters.

In general, one of the points at which criticisms can be levelled in lubrication systems is the absence or paucity of filters. In our opinion, it is a most important matter that oil, whether constantly circulating or not, should be maintained as free from foreign matter as possible. It is, in fact, almost inconceivable that one could have too many filters introduced into a system. If the objection be made that they are liable to clog up, and in doing so require frequent cleansing and attention, this is clear proof that their presence is beneficial. If a filter be used, and if after months—one may almost say years—of work it does not clog up, this may be taken as an indication that it is superfluous, but a lubrication system in which this would happen is scarcely to be imagined. It is not merely enough to filter the oil when pouring it into whatever form of containing vessel is used from which the oil is subsequently drawn. When oil is being worked between wearing surfaces it rapidly loses its lubricating qualities, not so much because these are destroyed by heat or by any internal change of a chemical nature, but because the oil gets filled with very small fragments of metal in a state of suspension. Before the used oil is replaced into circulation it is therefore advisable that these particles of metal should be removed, which can obviously only be done by very careful and complete filtering. It may be urged that if the bearings are kept flooded by lubricant little harm can result in the fact of these metallic particles being present, but this view is scarcely tenable when subjected to careful consideration. Lubrication is only effective when an unbroken film of oil lies between the working surfaces. Whatever the load on these surfaces be, within reason, the oil film is not destroyed provided it be maintained at sufficient pressure. Failure in the oil film may easily be brought about by an accumulation of small particles of metal, which produce a metallic contact between the working surfaces, and, secondly, set up an unnecessary increase of friction. It is for this reason that a positive high pressure oiling system has so much to commend it. A high pressure in itself is almost sufficient to ensure that no such collection of particles can form in ordinary circumstances, and not only so, but, given sufficient pressure, the oil can be forced through filters capable of almost entirely removing the impurities which have gathered in the course of circulation. If this be not done (and a great deal more care might be exercised in this respect) the conditions are practically analogous to a laundress having only a single bucket of water for a week's washing, adding, we will suppose, a few drops of fresh water at intervals to make up for loss by evaporation and what was carried away by the clothes themselves.

In some cases filters of unusual size and number are used, but there is a common and a bad tendency to make them much too large in mesh. It appears that in some cases the function of the filter has been conceived to be that of arresting such things as bolts, nuts, etc., that may get thrown around inside the engine. Attention is rarely given to the importance of making the mesh small enough to catch the much more subtle smaller fry which are none the less capable of doing a lot of damage.

The ideal system should contain first of all a filter of medium mesh in the filler cap, secondly a filter of fine mesh between the oil supply and the suction valve of the pump, thirdly an extremely fine filter of some such material as thin felt between the pump delivery and the bearing surfaces. This means that the oil is progressively filtered on each circuit. Impurities will, however, be deposited wherever the used oil has a chance to collect, and the bottom of the crank chamber should therefore be formed of a shape which will encourage such impurities to precipitate themselves into a readily detachable trap by means of which they can from time to time be removed. It is of extreme importance that all the filters be made as accessible as possible. Cleaning them out is not an inviting job either to the chauffeur or an owner-driver, and it is made no pleasanter if half the engine has to be taken down before this performance can be successfully completed All filters should also be large in diameter, so as to be capable of working for a long time without the liability of clogging up. If a felt or other fabric diaphragm be used it should be arranged so as to be thrown away and a new one inserted from time to time.

Indicators.

Four types of indicators are in general use by means of which proper working of the oiling system can be ascertained. All are fairly equal in popularity, though if anything the commonest is the plunger type. This consists of a small cylinder introduced either into the direct oil circulating pipe coming from the pump or into a separate by-pass pipe. This cylinder contains a plunger normally held down by a spring, and carrying externally a visible head piece which shows at a glance if there be any pressure in the circulating system or not. Immediately this fails the spring returns the piston and its tell-tale head to a position which is obviously different from that which it occupies normally. The advantage of this type of indicator is that when it cannot be seen its evidence can be obtained through sense of touch.

The second type is the ordinary pressure gauge or manometer, which, of course, requires some artificial illumination to make it of any use at night. On the other hand its reading is informative, since it shows at a glance not only whether the oil is circulating or not but the manner in which it is circulating also. The drip indicator performs much the same office as the pressure gauge, enjoying the advantage of showing how the pump is working. It sometimes provides a ready means by which small adjustments can be accurately made. Its disadvantage is, however, that in time the glass is liable to get clouded and that even at the best of times it is not very easy to see and gauge the oil flow. The fourth type of tell-tale is a rotary one, consisting practically of a light free-running form of gear pump, the pinions of which are placed under a glass lid so that they can be seen revolving in the flow of oil.

Position of Oil Vessel.

In the great majority of chassis the supply of oil is intended to be carried in the sump formed in the lower half of the crank chamber; in which case some form of gauge is used, generally consisting of maximum and minimum run-off cocks, placed so as to be easily get-at-able. The amount of oil thus carried varies

considerably in different engines. In some cases the volume of the sump has been cut down to rather a low capacity, so that it requires replenishing considerably more frequently than the petrol tank. This is rather a mistake, as filling up with oil is necessarily at the best of times a somewhat messy job, and no possible harm can be done when designing a sump to make this a matter of weekly rather than daily attention. The oil supply on some cars is carried on the dashboard, in others on the engine in a box attached either to the side of the crank chamber or to the cylinders, and in still others in a tank attached to the side of the frame. Somewhere underneath the bonnet is, however, clearly the best place, because the temperature is there much more equable than in the outer atmosphere—a matter of little importance during threequarters of the year, but by no means negligible in winter, especially when the pump has lost some of its efficiency through wear.

Arrangement of Piping.

It does not appear to have yet been decided which is to be preferred, internal cast-in ducts or external piping. On the score of appearance (or rather, disappearance), freedom from the ill-effects of vibration, simplicity, and cheapness, there is much to be said for the first-named arrangement. On the other hand, it may easily be argued that these ducts may lead to weaknesses in the crank chamber casting, as well as being difficult to get at in case of accidental stoppage, to which their roughness and necessarily sharp angles make them more liable than pipes. There is no doubt that in a good many cases they give trouble in the foundry, for a three-eighth inch diameter core running the whole length of a six-cylinder crank chamber requires considerable art in manipulation. There may often also be some slight difficulty in clearing such cast-in ducts of foundry sand, quite a little of which is of course capable of doing considerable harm when eventually moved along by the oil circulation. One great advantage of the external pipe system is that in the event of there being any doubt as to whether there is a stoppage in the circuit the undoing of a union whilst the engine is running will speedily put such doubts at rest, whilst, in the event of foreign matter causing obstruction, detachment of the pipe and cleaning it out should be matters of a few moments only.

Individual Systems Described.—Section I. Purely Mechanical.

The black lines in the diagram fig. 1 (which represents no particular engine) indicate the circulation of oil in the general type.

Delaunay-Belleville.

The base of the crank chamber is formed into an inclined sump, at the rear end of which is a direct-acting oscillating plunger pump driven off the crankshaft. The cylinder of this pump is so mounted on its trunnion that it forms its own valve with the trunnion housing. The pump delivers through a detachable filter attached to the side of the crank chamber into a duct cast into the base, from which pipes branch to the camshaft and crankshaft bearings. Both the crank pins and the connecting rods are hollow, and the oil is, therefore, forced direct to the big end and also to the hollow gudgeon pins, out of which it flows on to the cylinder walls. These are also lubricated from the excess of oil thrown up from the big ends of the connecting rods. Incorporated in the filter is a relief valve, which, when the pressure rises to a pre-determined amount, allows the superfluous oil to be returned to the sump. A pressure gauge fitted to the dashboard shows how the circulation is proceeding.

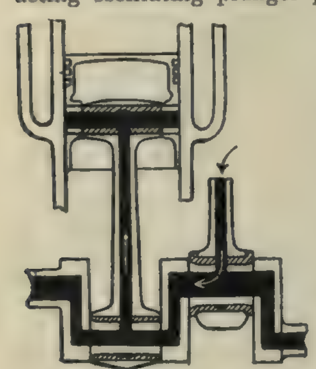


Fig. 1.—Diagram of scheme of oil-feed in positive lubrication.

Lanchester.

Contained in the crank chamber is a skew gear-driven pump actuated by a phosphor bronze worm ring carried on the flywheel end of the crankshaft. Oil is drawn through a filter from the inclined sump of the base chamber, and is delivered direct through a long external pipe to the seven main bearings of the crankshaft, which is hollow. Thence the oil is forced through the big ends, from which it passes to the gudgeon pin and the cylinder walls through a hole drilled in the connecting rod. The oil supply is carried in the crank chamber sump. A piston type of tell-tale, which rises when the engine starts, is fitted to the driver's control plate. The sump is provided with an oil level cock. A special feature of the Lanchester is the high pressure of circulation, which is about 40 lbs. to the square inch when the engine is running at normal speed. A blow-off valve is used to prevent the oil pressure rising to an excessive degree.

Maudslay.

The crank chamber sump, which contains a supply of oil poured into it through one of the eight large crank chamber manholes, is divided by a transverse partition into two compartments, from each of which oil is drawn by a pinion pump driven by an extension of the valve shaft vertical drive. Oil is delivered direct to all the main bearings, and thence through the hollow crankshaft to the big ends, after which it passes up the tubular connecting rods to the gudgeon pins. The cylinder walls are lubricated through the excess of oil which flows down the inside walls of the pistons. A large sized filter is fitted, and there is also an oil level indicator of the float type, which is carried direct in the sump. A plunger type tell-tale on the dashboard indicates the working of the system.

Metallurgique.

The sump at the bottom of the crank chamber contains a supply of oil, which is kept on the 15-20 h.p. model as cool as possible by means of radiating fins cast on to the lower surface of the sump. The height of oil is visible by means of a float which is carried in the filler cap. The front can be emptied by opening a draw off cock, which is carried on the off side of the crank chamber. Level with the base of the sump, and drawing its supply therefrom through a multiple filter, is a rotary pinion pump, which circulates the lubricant direct to the three main bearings of the crankshaft, and thence through the hollow webs and pins to the big end bearings, after which it passes up pipes laid in the channels of the connecting rods to the gudgeon pins; the pistons, cylinder walls, and camshafts being lubricated by the splash, which exudes at the edges of the big end bearing. A pressure gauge is carried on the dashboard to indicate whether the system is working at the right pressure, whilst an adjustable release cock, or by-pass, which

allows any excess of oil to fall on to the distribution gear, can be regulated so that the supply attains any desired pressure.

Rolls-Royce.

A gear pump placed at the bottom of the crank chamber sump is driven by the lower end of the vertical shaft, which actuates the high-tension distributer of the coil and accumulator ignition system. This pump draws oil through a filter and discharges it to the three main bearings; these are at each end and in the middle of the crankshaft, which is hollow. Through the internal channels the oil is forced to the big end bearings and to the smaller intermediate bearings of the crankshaft. The connecting rods carry small copper pipes, which lie in the channel at one side, and oil makes its way through these pipes to the gudgeon pin and the cylinder walls. The oil pump is provided with means of adjustment whereby the pressure may be regulated from 1 lb. to 20 lbs. to the square inch, which is registered on a pressure gauge on the dashboard. One of the special features of the Rolls-Royce system is the fact that within certain limits the oiling of the cylinder walls is proportional to the load. A patented form of valve is brought into operation by the accelerator pedal when the latter is moved through about two-thirds of its stroke and directs an additional supply of oil through outside piping to the thrust wall of each cylinder. Attached to the chassis frame on the near side of the engine is an extra oil tank, which supplies oil to the engine sump according to requirements.

Sheffield-Simplex.

Oil for lubrication of the engine is forced to all bearings by means of a positively acting pump carried at the end of the camshaft. This pump draws oil through a filter in the base of the engine and forces it along the main feed pipe extending the whole length of the crank case. From this pipe oil-ways extend to the main journal bearings of the crankshaft, and also to each of the bearings supporting the camshaft. The crankshaft is hollow, and the oil is delivered to the main journal bearings through the pipe so formed, along the interior of the crankshaft to the supplementary journal bearings and on to the connecting rods, after which it passes along pipes in the sides of the connecting rod to the gudgeon pins, and from the latter on to the cylinder walls. The pressure of the oil is kept at the necessary constant by means of an adjustable by-pass valve fitted to the pump and indicated by a gauge on the dashboard in view of the driver. When the pressure exceeds that required, the by-pass valve opens and permits the surplus oil to pass back again into the sump at the bottom of the engine, and in so doing to pass over the timing gears, lubricating them and keeping an oil bath to a constant level through which the driving chain is continually circulating. The capacity of the pump is such that at all speeds it is capable of delivering an excess of oil, so that there is an ample quantity always flowing through the by-pass valve to lubricate the timing gears and chain. The oil in circulation is carefully filtered, the filter being easily removable for cleaning purposes, and is so arranged that when taken out the valve automatically closes and prevents an escape of oil from the engine. All of the leads and pipes are contained inside the crank case. The supply of oil is put into the sump through a large circular opening on the magneto side of the crank chamber. This opening is covered with a circular plate held in position by a flat spring lever, which is connected with a cock in the crank chamber, that indicates the exact level of oil. When the lever is moved to enable the circular plate to be lifted it automatically opens the level cock, and when the plate is replaced and the spring lever brought back into place the cock is automatically closed again, preventing it being inadvertently left open at any time and so causing a waste of oil.

Star.

Force-feed lubrication to all parts is employed on Star engines by means of a gear pump driven off the end of the camshaft. This draws oil from the crank case sump through double gauze filters and forces it to the crankshaft journals and camshaft bearings. The crankshaft is drilled so that the oil is led from the journals to the big end bearings and thence, on the larger models, by pipes leading up the connecting rods to the gudgeon pin bushes. All the oil delivery pipes are cast solid with the crank case, and, to prevent excessive oil pressure, a release valve of the mushroom type is fitted at the front end of the main oil passage. Any excess of oil is discharged into the timing case and lubricates the silent chains driving the camshaft and magneto. The spring of this relief valve is adjustable so that the maximum oil pressure can be set to any desirable degree. Ample provision is made to obviate the oil pump running dry, as non-return ball valves are fitted both above and below it, and, in addition, a priming tap is fitted through which the oil pump may be filled after the engine has been stationary for any considerable period. An indicator of the plunger type is carried on the dashboard and shows that the oil is circulating properly.

Section II. Semi-mechanical.

There are two principles in common use, and this section may therefore be sub-divided into systems which employ a mechanical feed both to the main bearings and the big end bearings, the rest being lubricated by splash, and those in which only the main bearings are positively fed.

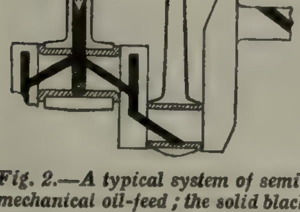


Fig. 2.—A typical system of semi-mechanical oil-feed; the solid black and the arrows indicate the oil flow.

Albion.

A box containing a mechanical pump and a supply of oil (the level of which can be ascertained through a gauge glass) is carried on the dashboard. The mechanical pump is of the direct acting plunger type, and is firmly mounted on a horizontal ratchet wheel in such a manner that its plunger is operated by a series of cams on the lid of the box, when the ratchet is rotated by an oscillating pawl driven from the camshaft. The one pump is made to feed in turn six separate pipes, which conduct it to the main bearings and thrust side of the cylinders and to the connecting rods. The latter are served by oil-retaining rings fixed to the crankshaft web; the oil pump after that forces it centrifugally through holes in the webs and crank pins to the bushes. The spindle of the ratchet mechanism passes through the lid of the box and terminates in a handle, which is used to indicate which bearing is being served by the pump. It also allows the pump to be operated by hand when an additional supply is required. Each feed is regulated by a screw-down valve.

Lubricating Systems.

Alldays.

A gear pump driven off the camshaft draws oil from the sump, which forms the supply, and delivers it *viâ* a pressure relief valve to an external distributing base, which directs it to the three main crankshaft bearings, whence it is taken by internal diagonal leads to the big end bearings. From here it is splashed on the other parts of the engine. When the pressure rises above a pre-determined amount the relief valve by-passes the surplus oil directly back into the sump. The latter is filled through a tube attached to its forward end. Copper pipes are used throughout for conveying the oil to the points of application.

Arrol-Johnston.

Oil is filled by means of a readily accessible orifice in the crank case into a sump forming the base of the crank chamber and so passes through a large detachable cylindrical filter to a rotary pinion pump driven off the crankshaft. It is then forced direct to the three main bearings, and thence through the diagonally drilled webs to the big ends, from which the excess is flung on to the cylinder walls, camshaft, etc. An adjustable screw-down valve is arranged on the end of the crank case by which the flow can be kept to the desired amount. The level of the oil in the sump is ascertained by means of a cock on the side of the crank chamber operated by a handle in an accessible position beneath the bonnet, and also by means of a graduated dipper rod.

Clement.

The crank case is filled through a conical cup provided with a filter to a level determined by an overflow tap. From the sump oil is drawn by a rotary pump of the pinion type and delivered direct to the main bearings and to the connecting rod bearings through the drilled crank webs. A sight feed indicator on the dashboard is operated through a branch pipe from the main delivery, and the flow from this sight feed is taken to the timing wheels. In the event of the sight feed indicator becoming clogged a small cock on the main oil pipe indicates whether the circulation is in action or not.

Crossley

Oil contained in the sump is drawn in through a filter by a gear pump attached to the extension of the camshaft, which forces it along a pipe having branches which direct it into the three main bearings, whence it passes through the drilled crank pins and crank webs to the big end bearings. The piston, cylinder wall, and gudgeon pin bearings are lubricated by the excess of oil which is splashed on to them, as also is the camshaft. The timing gear in the front of the engine is lubricated direct from the pump through a separate pipe. A pressure gauge is fitted on the dashboard and is connected with a by-pass valve, which allows the feed to be adjusted in regard to pressure. The height of oil in the sump is indicated by means of a graduated stem working inside a glass tube which is operated at its lower end by means of a float.

De Dion Bouton.

The supply of oil is carried in the sump, over which is a sheet metal gauze extending over its whole surface. The pump is of the pinion type driven from the front end of the camshaft, and forces the oil direct to the camshaft bearings and also to the main bearings of the crankshaft, whence it passes to the big end bearings through the drilled crankshaft. A by-pass or return valve is provided to prevent excessive lubrication at high engine speed, and a combined oil level gauge and draw off cock is mounted on the side of the sump.

Delage.

The principal supply of oil is carried in the sump below the base chamber of the engine, but there is also a large subsidiary tank mounted on the dashboard. This serves for increasing the volume of oil carried, and also for reducing it in temperature in the course of circulation. A pinion type pump carried at the bottom of the sump directs the oil to the tank on the dashboard, whence it falls to a union which distributes it first of all to the four main bearings of the crankshaft, whence it proceeds to the big ends through holes drilled in the pins and webs. Another pipe conducts it to the timing gear at the front end of the engine, whilst a third lead is taken up to a pressure gauge on the dash. Mounted on the timing gear case is a pressure release valve by means of which the supply of oil passed to all the bearings can be easily regulated. Three filters are incorporated so that the oil is freed from impurities throughout its circulation.

Delahaye.

A gear pump level with the base of the sump draws oil therefrom and passes it to the three main bearings of the crankshaft, which is drilled to allow the oil to pass through to the big end bearings, and afterwards to the other working parts by splash. The working of the system is indicated by a manometer on the dashboard, and the supply is controlled by an adjustable needle valve supported at the side of the crank chamber. Contained inside this valve is a gauge rod, by the moving of which the amount of oil in the sump can be readily ascertained, and also a special filler cap, through which the sump is replenished. The emptying device by which the required level of oil can be obtained is very ingenious. When the emptying valve handle is turned to its open position, only a small quantity of oil is run out, and no more overflows, even should the handle be left in that position. To empty a further amount the valve is turned to its shut position, when the small cup it contains is filled and upon turning the handle another small amount is discharged.

Enfield.

The supply of oil is contained in the sump beneath the crank case, whence it is drawn by a rotary pump, driven by a spiral gear on the camshaft and delivered to a distributer pipe, which conducts it through an external pipe to the three main bearings to the crankshaft. The crankshaft being drilled, oil passes from the main journals to the big end bearings, after lubricating which it exudes in the form of a fine spray and is distributed over all the working parts, including the camshaft, piston walls, gudgeon pins, etc. A pressure gauge mounted on the dashboard indicates the correct running of the system. The oil, during its circulation, is thoroughly well filtered before being sent to the bearings. In order to prevent any possibility of the big ends dipping into the oil supply and causing the engine to get foul, plates are fitted across the top of the oil sump. At the side of the crank chamber is mounted an indicator of a simple float type, which gives a reading of the level of oil existing in the sump. A spring operated relief valve is incorporated in the circulation, and is fitted with a simple means of adjustment, so that the pressure at which the oil supply is carried out can be regulated according to requirements.

Hotchkiss.

This system comprises a sump arranged in the usual way and is distinguished by the design of the pump. This is of the direct plunger type with an oscillating

cylinder, the piston being operated by an eccentric mounted on the end of the crankshaft. The combined connecting rod and piston is hollow and the boss of the connecting rod is arranged with a segmental port, which performs the function of a cut-off valve at the correct point of the stroke. At the top of this stroke the plunger opens ports in the cylinder, through which oil flows and displaces the partial vacuum created. On its down stroke oil is forced up the plunger through the port in the eccentric boss and thence to the drilled crankshaft, by which means oil proceeds to the main shaft bearings and also to the big ends, through which the excess is sprayed on to the cylinder walls, camshaft, and gudgeon pins. Surrounding the oscillating cylinder of the pump is an inverted bell containing a filter, and the mouth of this is brought close down to the base of the sump to ensure that the last drop of oil therein has passed into circulation. The drawing illustrates the design of the pump, and also shows the small release valve which is used to prevent the pressure rising too high. A pressure gauge is fitted to the dashboard, and the level in the sump is verified by two overflow cocks.

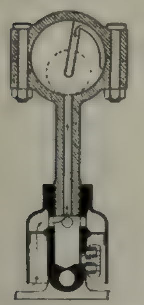


Fig. 3.—Section of the Hotchkiss oil pump.

Humber.

The oil contained in the sump is forced by a pinion pump located in the bottom of the sump upwards through a vertical pipe communicating with another pipe cast in the crank chamber and leading to each of the three main crankshaft bearings, oil being then taken to the big end through diagonally drilled webs. A tell-tale pressure indicator fitted on the dash is coupled up to the system to indicate that the circulation is in proper operation. In daylight this fitting can be seen, and at night it can be easily reached so that by a slight pressure of the finger one can tell if everything is in order. An adjustable spring-loaded relief valve short circuits the oil from the main valve back to the pump when the pressure rises too high. The above applies to the 11 h.p. and 14 h.p. car. In the 10 h.p. model the oil pump is driven direct from the camshaft and drawing its oil from the sump, delivers it to a branch pipe communicating with an oil receiver attached to each of the three crankshaft bearings. Also another branch pipe delivers oil to four dipper troughs, the oil from which overflows back into the sump; the dipper on each connecting rod splashing into these troughs keeps the big ends supplied, and the spray from the same also lubricates the system.

Mercedes.

The oil supply is contained in the crank chamber, from which it is drawn by a special type of plunger pump and forced directly to the crankshaft bearings, and thence to the connecting rod big ends, the rest of the moving parts being served by splash. To prevent over-lubrication to the pistons special baffle plates are provided in the base chamber. An adjustable sight-feed is fitted to the dashboard. A reserve supply of oil is provided by the oil container situated at the rear of the engine base chamber. From this a pump automatically takes a small quantity of oil from the reserve supply and forces it into the oil circulation, ensuring a constant level of oil in the main sump. The oil pump is fitted with a worm drive, and is operated from the water pump driving spindle.

Napier.

A supply of oil is carried in the sump or oil tank under the engine, and is pumped by means of a gear wheel pump of the pinion type to the main crankshaft bearings, whence it is fed by means of oil-ways drilled in the crank pins to the big end bearings. In order to ensure the oil being kept at the right level in the sump an overflow cock is fitted which is arranged in conjunction with the cover of the oil filler, so that when the latter is opened, in order to replenish the engine with oil, it opens the overflow cock, which is of such large dimensions that any volume of oil put in over and above the correct amount immediately runs out again. The excess of oil which exudes from the edges of the main bearings and the big end bearings is splashed from there on to the pistons and lubricates the cylinder walls and the gudgeon pins. Baffle plates prevent an excess getting on to these parts. After performing this function the oil runs down on to specially arranged gutters, which direct it to the cams, and also lubricates the camshaft bearings. A lead is carried from the supply system up to the skew gear bearings in the front of the engine, which drives a magneto and water pump spindle. Two filters are fitted to the oiling system to prevent dirt or any foreign matter from being circulated into the bearings. Both of these filters are very easily and readily got at for cleaning purposes. A relief valve is fitted so that the pressure of the circulation can be adjusted. A tell-tale gauge is fitted to the dashboard and indicates to the driver if the system is working properly or not.

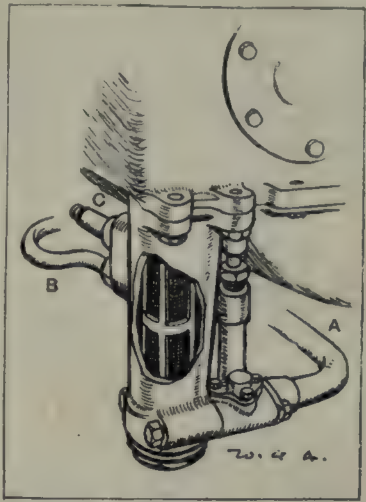


Fig. 4.—The Napier pump arrangement showing the position of the filter. A is the suction pipe, B the delivery, and C the relief valve.

Peugeot.

In this system the oil is forced by a direct acting plunger pump driven from the camshaft to the three main bearings of the crankshaft, after exuding from the ends of which it is caught by thrower rings which direct it by centrifugal force to the big end bearings through diagonal holes drilled in the crank web. On escaping from these bearings it falls into troughs, forming a false bottom of the crank chamber, and from here it is splashed by the big ends on to the piston, cylinder walls, camshaft, etc. The supply of oil is retained in the sump and is adequately filtered before being placed in circulation. The pump also supplies a pipe which conducts oil through the timing gears in the front of the engine. A pressure gauge mounted on the dashboard indicates the correct working of the system, and a special arrangement is provided whereby it is ensured that this gauge cannot run short of oil. The pressure of the system is easily regulated by means of a release valve, and a draw-off tap and oil level indicator are provided to show the height of lubricant in the sump.

Lubricating Systems.

S.C.A.T.

A pump level with the base of the sump forces oil to the three main crankshaft bearings, and through the hollow shaft to the big ends, whence it is thrown on to the cylinder walls, gudgeon pins, and camshaft. The pump itself is driven from a vertical spindle actuated by the camshaft, and is placed in an accessible position outside the sump.

Sunbeam.

In the Sunbeam engine copper oil leads are used, and the rotary pinion pump is placed slightly lower than the base of the sump and actuated by a long vertical skew gear-driven shaft. The five crankshaft bearings are fed from a large diameter copper tube, and thence oil passes through the drilled webs of the crankshaft to the big ends, after which it is splashed on to the cylinder walls and gudgeon pin bearings. A piston type of circulation indicator is carried on the dashboard, so the driver is immediately able to see whether his lubricating system is functioning properly or not.

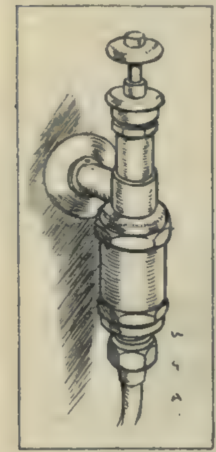


Fig. 5.—The plunger oil indicator on Sunbeam cars.

Swift.

The lubricating oil is forced by means of a gear pump driven by worm gearing to the main bearings of the crankshaft. It thence is conducted by holes drilled in the crank webs to the connecting rod big ends. A pipe runs to the tell-tale on the dashboard, and the oil, after passing through this, is led to a chamber on the chain cover, from which it is distributed by pipes to the silent chains and crankshaft bearings. The camshaft bearings are lubricated by cups cast on the bearings, which are filled by splash. The oil is contained in the sump in the bottom of the crank case, to which a level tap is fitted, also a large filler on the side of the crank case which contains a gauze strainer. A filter of good proportions is also fitted in the pump.

Talbot.

A sump cast in one with the crank chamber acts as an oil container and is provided with a rotary pinion pump driven from the camshaft. This forces oil, after drawing it through a filter, direct to the main bearings, whence it proceeds from the big ends through the hollow crankshaft. The excess which is forced out through the end clearance of the bearings is splashed on to the cylinder walls, gudgeon pins, camshaft, etc. The main delivery pipe is branched to a pressure gauge on the dashboard, ranging up to 25 lbs., and the normal pressure is about 12 lbs.

Vauxhall.

This system employs the usual sump and pressure feed to the main bearings and to the big ends through the drilled shaft. Copper piping is used throughout in place of ducts. The pump is of the direct acting plunger type driven by a ball bearing eccentric carried on the ends of the camshaft. The pressure of the circulation is registered by a gauge on the dashboard, and this also carries a small tell-tale, which makes a movement with every stroke of the pump. The latter is readily detachable complete. A float inside the sump indicates the level of the oil therein. A neat feature of the Vauxhall is the valve by which dirt or other residue is removed from the sump without letting out more than a minimum quantity of oil. A section of this valve is shown in the accompanying sketch, which clearly indicates its working. Normally, the inverted cap holds the mushroom valve off its seat. Upon unscrewing the cap it brings away with it the oil residue which has collected beneath the valve. The latter then seats itself and prevents any oil passing until the cap is replaced. The latest type of Vauxhall engine has a large strainer tray between the crank chamber and the pump. This tray can be drawn out at the front by removing eight bolts which hold it in position.

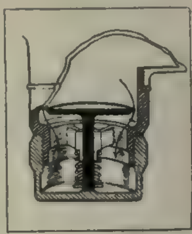


Fig. 6.—Section of the Vauxhall sludge valve

Vinot.

This differs in several respects from the general type. A vertical gear pump, driven from the crankshaft and carried at the end of the sump nearest the flywheel, delivers oil to the centre main bearings of the crankshaft, which is hollow throughout, and by this means oil reaches the other two main bearings and the big ends, from which it is splashed on to the cylinder walls, etc. It is returned to the sump through ducts drilled in the main end bearings, the front one of which also communicates with a duct, giving a positive feed to the camshaft. A relief valve returns any excess of oil to the sump, and oil is passed through two filters on each circuit.

Section III. Mechanical to Main Bearings, Splash to Other Parts.

Adams.

Oil contained in the crank chamber sump is forced by a pinion pump operated by a vertical shaft skew-gear driven from the camshaft through a piston-type tell-tale on the dashboard, and thence direct to the main bearings and timing gears. It also delivers to shallow troughs cast in the top of the sump and coming immediately under the big ends of the connecting rods. The big ends are provided with scoops which splash oil on to the rest of the moving parts. A filter is placed between the sump and the suction port of the pump. The level of oil in the sump is indicated by a three-way cock of easy access.

Argyll.

On the Argyll sleeve valve engines the oil is circulated by a gear pump driven from the valve operating shaft and is drawn from the sump in the base chamber. The oil level is indicated by a float, which is conveniently placed on the inlet side of the engine. The float wire passes through an ordinary spring lid lubricator, so that to find if there is oil in the sump it is only necessary to lift up this lid. The oil pump discharges into a steel-lined duct, which is carried in the crank chamber, and from which it is led to the main crankshaft bearings by suitable passages drilled in the bearing hangers. Oil jets are arranged so as to direct the lubricant on to the sleeve operating gear and the sleeves themselves. The bearings and sleeve gears are thus lubricated by pressure. The oil pump also feeds to troughs placed immediately under the big ends of the connecting rods, and these are fitted with dippers for supplying these bearings and also for splashing the excess of lubricant on to the cylinder walls. The base chamber is furnished with cooling ribs cast on the bottom of the sump, which is open to the air. The oil is filtered twice on each circulation.

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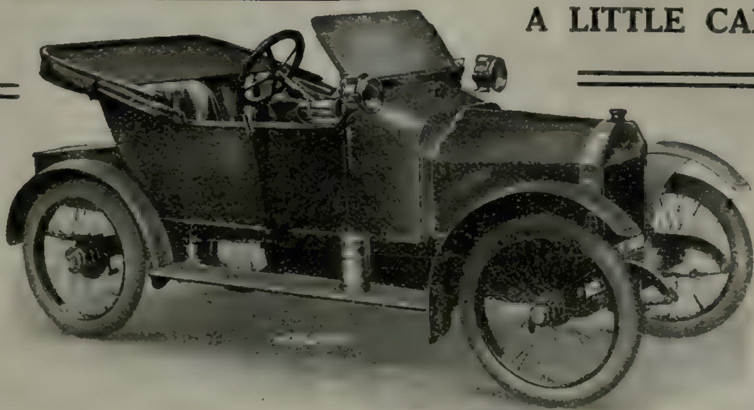

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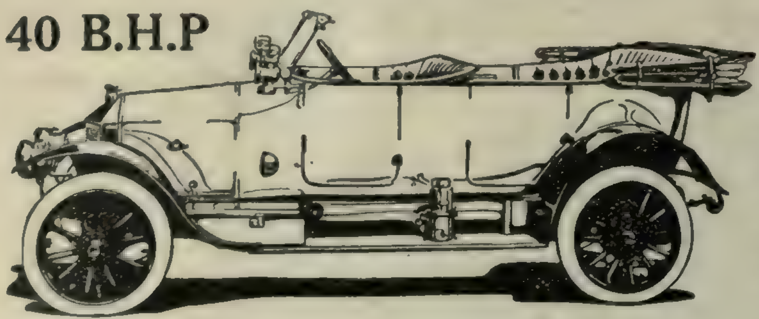

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Austin.

Two rotary pinion pumps driven by skew gearing from the camshaft draw oil from each end of the sump, thus preventing the possibility of the supply being interfered with when the car is standing on a steep gradient. Oil is passed to the five main crankshaft bearings, from which it is thrown by centrifugal force on to the deflectors fitted to each side of the crank webs. The function of the deflectors is to throw the oil into the hollow crank pins and so to the big end bearings. Excess is splashed on to the cylinder walls, gudgeon pin, and camshaft. The two oil pumps are both driven by the same shaft, and either is sufficient to maintain an efficient circulation. Underneath the crankshaft are fitted two sloping trays joined by a gauze strainer which forms the top of the sump. The arrangement of these trays is such that even when running on an extremely steep gradient there is no likelihood of the oil in the sump coming into contact with either front or rear big ends, and so forming a smoky exhaust. A graduated gauge shows the amount of oil supply, whilst a pressure gauge forms an indicator on the dashboard. A by-pass relief valve is fitted to the main oil delivery pipe.

Austro-Daimler.

The lubrication system used is pressure feed on the Friedman patent system employing a multiple pump. A number of oil leads are taken from the lubricator, and to each oil lead there are two plungers, one of which is a piston valve and the other the positive pump. A very high pressure is obtained, and the lubricant is forced to the main bearings and the thrust side of the cylinder walls. The pumps consist of steel pistons working in stout phosphor bronze barrels, and the pump actuating mechanism is driven off the crankshaft by helical gearing. All the lubricating mechanism works in the oil which it pumps. The accessibility of the design is very marked, for on detaching the lid of the reservoir the whole of the pumping apparatus which is attached thereto comes away and can be easily inspected or adjusted. The throw of each delivery pump can be altered, and consequently the amount of oil delivered to each lead. A sight-feed gauge is fitted to the oil reservoir. Each connecting rod big end bearing dips into a separate trough, so that the engine can be tilted without starving the big end bearings at the higher end. The gudgeon pin bearings are lubricated by splash.

Belsize.

The supply of oil is contained in the sump below the crank chamber, from which it is drawn by means of a gear pump, which conducts it to the circulation indicator on the dashboard. This shows at a glance whether the system is working correctly. From this indicator it is fed to an oil duct, cast in the upper half of the crank chamber, from which it passes to the crankshaft by means of drilled holes, which lead to the bearings. Underneath the big ends are troughs fitted to allow the big ends to dip, the troughs being maintained at a constant level with oil from the main ducts in the upper half of the crank chamber; all overflowing oil from the crank bearings and troughs passes through the removable filter into the sump and is then put into circulation again.

Brasier.

These cars are fitted with a type of semi-forced lubrication system in which a pump draws oil from the supply tank, which is contained in the sump below the crank chamber, and passes it direct to the main bearings of the crankshaft, and also through a second distributer pipe and four troughs, which are arranged immediately underneath the big end bearings. The connecting rod big ends are furnished with scoops, by means of which a splash of oil is forced direct on to the bearings, whilst the ensuing spray falls on all the other working parts and lubricates them adequately. The unused oil returns to the oil tank through a special type of filter, which can easily be cleaned from the outside of the engine. The oil is fed to the tank through a funnel, which is fitted with a level gauge which ascertains the amount of oil existing in the sump.

Benz.

Oil is poured into the crank chamber sump through a cone-shaped filter. Situated at the side of the crank case, and driven by a worm gear from the camshaft is a specially designed plunger pump which directs oil through a sight feed to the main bearings, and also to troughs cast in the top of the sump immediately under the connecting rod big ends. The pump draws and discharges through filters which are easily get-at-able. The arrangement of the positive pump is shown in the sketch fig. 7. It is furnished with a combined reciprocating and rotating action, and is entirely valveless. A small portion of the pump body is square in section, and carries loosely on it the worm pinion by which it is driven. The upper end of the pump body is furnished with a helical groove in which runs a small fixed set-pin, so that, upon being rotated, the plunger of the pump reciprocates to and fro. At the base of the plunger is provided an L-shaped port which communicates in turn with the intake and delivery orifices which are placed at either side. The sight feed is of individual type, and consists of a white enamelled surface over which the oil flows like a miniature waterfall. This indicator is carried on the dashboard.

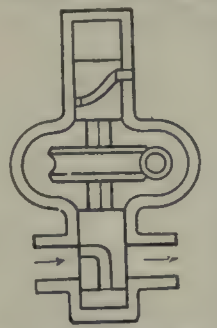


Fig. 7.—A diagram of the Benz combined rotary and reciprocating pump.

Brennabor.

On the rear pair of cylinders is bolted a box serving as an oil vessel, and containing also two direct-acting plunger pumps driven by a skew gear and eccentric sleeves from the camshaft. Each pump is double acting and supplies two outlets. Of these, three lead to the main engine bearings, and the fourth to the thrust collar on the clutch fork. The crank chamber is divided by a transverse wall into two parts, each of which serves two big end bearings by splash. The oil is also sprayed on to the cylinder walls, gudgeon pins, camshaft, etc. The timing wheels are lubricated direct from the forward crank chamber compartment, oil being splashed through an aperture in the dividing wall. The delivery from the positive pumps is adjusted by altering their stroke, which can be done with very great accuracy by special means provided for the purpose.

Fafnir.

A pump driven by the engine returns oil from the sump below the crank case, which serves as a tank, and delivers it under pressure to the three crankshaft bearings. This oil is then conveyed to the crank pin bearings through splash rings and oil webs which are provided in the crankshaft. The oil which is exuded is splashed on to the cylinder walls and lubricates the piston and gudgeon pin bearings, camshaft, etc. A

Lubricating Systems.

tell-tale is fitted which shows that the lubrication system is in proper working order through a plunger attached to the dashboard.

La Buire.

A pinion pump, driven through an inclined shaft skew geared from the camshaft, is placed at the bottom of the sump, from which it draws oil and forces it through a rotary indicator on the dashboard to a cast-in distributing duct which leads it to the main bearings. Pipes from the same pump also feed troughs placed in the big end bearings, the latter being furnished with large scoops, serving not only to direct the oil to the bushes but to spray it all over the working parts. At the side of the sump is a double valve which in different positions of a lever serves both for the emptying and filling in of oil.

Martini.

A large sump contains the oil in the base chamber. A plunger pump driven by an eccentric on the camshaft draws the oil from the sump and delivers it to the main bearings and also to four troughs into which the connecting rods dip. The level of oil in these troughs being constant, there is no possibility of the engine being over-lubricated. A dial on the dashboard indicates the pressure of oil in the pipe. If the supply of oil be deficient the driver is warned of the fact by there being no pressure shown on the dial. The pressure is controlled by a relief valve which is provided in the circuit. The oil pump and the filter are easily detachable for cleaning purposes.

R.M.C.

The lubricating system used on this car is extremely simple, though efficient. From a sump beneath the crank case oil is drawn through a filter by means of a plunger oil pump, driven by an eccentric on the camshaft, and it is thence delivered in excess to pockets over the main bearing, from which it overflows and runs down into the crank case. Here it forms a constant level, overflow pipes at a certain height returning the surplus to the sump, and into this oil the big ends of the connecting rods dip at every revolution, supplying the cylinder walls and gudgeon pins by splash. The small ends of the connecting rod are also lubricated by this means there being pockets arranged in the piston.

Rover.

A sump beneath the crank chamber serves as an oil tank, and from this oil is drawn by a rotary pinion pump placed at the lowest point of the sump and operated by a vertical shaft actuated by a skew gearing from the camshaft. The pump supplies the four troughs placed underneath the big ends, which are furnished with scoops for oiling themselves and for splashing on to the other parts of the engine, and also the chain-driven distribution gearing. A division between the crank chamber and the sump is formed by a gauze diaphragm, through which excess of oil drips back into the sump.

Sizaire-Naudin.

(15 h.p. model.) A skew gear driven pinion pump takes oil from the crank chamber sump, wherein it is contained, and delivers it direct to the two main crankshaft bearings, whence it passes through the drilled webs of the big end bushes, the camshaft pistons and gudgeon pins being oiled by splash. A pressure gauge fixed on the dashboard is included in the circuit.

Standard (large models).

Oil is contained in the sump below the crank chamber as well as in a supplementary tank inside the bonnet. At the base of the sump is an eccentric paddle type of pump in which vanes are held against the walls of their eccentric chamber by springs. The pump is provided with a relief valve allowing excess of oil to be returned to the base chamber. On the dashboard is an oil circulating indicator of the piston type which can be both seen and felt. From here the oil passes to a combined filter and distributer which leads it to each of the main shaft bearings and also to the timing gear. Attached to the crankshaft and overlapping the flanges of the main bearings are annular gutters which collect the overflow and convey it through holes in the webs to the connecting rod bearings, leaving which it is sprayed on the cylinder walls and returned to the base chamber. An ingenious arrangement is adopted to allow the driver to ascertain whether there is a sufficiency of oil in the base chamber without getting out of his seat. On the steering column is a small rubber bulb connected by a pipe to a point representing the minimum level of the sump. This pipe also contains a small whistle. Pressing the bulb blows the whistle if the bottom orifice of the pipe be covered by oil, but if not the whistle is not blown. Should the engine be started up with the oil below the level of the pipe the alternating pressure in the base chamber at low engine speed blows the whistle and so gives the driver due warning.

Straker-Squire.

The crank chamber sump acts as an oil supply, and is fed through a large conical filler on the offside of the engine and provided with a filter. The lubricant is circulated by means of a pump driven by skew gearing off the camshaft. This is so arranged that it is contained in the top half of the crank case, thus allowing the sump to drop for inspection without the attendant difficulties of getting the pump back into place when it is placed in its usual position. All five main bearings of the crankshaft are fed under pressure by separate copper pipes leading from the pump. The latter also supplies troughs by means of a long copper pipe going the entire length of the top half of the crank chamber. Dippers on the end of the connecting rods splash into these troughs and lubricate the big ends and also the cylinder walls. The latter are provided with baffles to obviate excessive lubrication. A lead taken from the pump goes up to a plunger tell-tale on the dash, which notifies the driver that the lubrication system is in order. The surplus oil from the tell-tale returns to the front end of the crank case and is used for lubricating the timing gearing. A gauge is situated on the off side of the engine, and may be pulled out and the amount of oil in the crank case immediately determined.

White and Poppe, Dennis and Singer.

At the lowest point of the sump, underneath the crank chamber, are two rotary pumps, one of which serves to draw oil from the reservoir (which can be placed in any convenient position on the chassis) and forces it to the working parts, whilst the other returns it after its circulation through a filter back to the reservoir. These pumps are driven by a vertical spindle actuated from the camshaft. The oil is led by external pipes to the main bearings, which are kept flooded. Excess of oil passes to troughs underneath the big ends, which carry scoops for taking it up and spraying it to the gudgeon pins and the cylinder walls. Gutters are formed under the partitions carrying the main bearings, so that oil splashed up is caught by them and pumped off again through these journals. In the Morris-Oxford engine, which is made by White and Poppe, the gear box and crank chamber form a single unit, and the flywheel is enclosed. The oil, which is contained in the crank chamber sump, finds

its way to the reservoir in which the flywheel dips. It is picked up on the periphery of the flywheel, and is caught by two V-shaped grooves formed in the flywheel cover. These grooves collect the oil under pressure and deliver it to all the parts of the engine and also to the clutch and gear box, through which it passes before being again circulated by the flywheel.

Wolseley.

Lubrication is maintained by an oil pump, which takes the form of the usual gear wheel type, driven off the camshaft, and it delivers oil through a distributing pipe carrying ducts which lead it to troughs above the main bearings. This pipe also leads to an oil jet over the timing gear and to the adjustable tap and indicator on the dash, whence the oil flows to the crank case sump. From the pump, the oil also flows to troughs under the connecting rod big ends. The oil is drawn by the pump from the sump up to a cup in which is contained an oil strainer. An oil level cock is provided and the filler on the near side of the forward engine bearer has a wide orifice and is provided with a strainer. The oil indicator on the dashboard gives a visible drip, showing whether the system is working correctly, whilst the supply to all the bearings can be easily adjusted by a small valve carried in the casting which supports the indicator window.

Section IV. Splash.

Ariel.

The crank chamber is not provided with a sump, but oil is carried in a separate container fixed to any convenient part of the chassis. Two oil pumps are used, and have for their functions, in the first case to draw oil from the tank and deliver it to troughs under the big end bearings, while the other returns excess of oil (which overflows from these and drips down into the crank case after being splashed to the other working parts) through a filter back into the tank. As the pump delivery from the engine is of larger capacity than that to the engine, any surplus oil which falls into the crank chamber after the engine has been standing for some time is quickly removed before it has a chance to be splashed up. A pressure gauge is fitted to the dashboard.

Bell.

The oil is contained in the crank chamber sump, whence it is drawn to a gear pump driven off the camshaft, this pump being furnished with a special priming piece. The oil is then forced up to the dashboard to a piston type of indicator, and is also directed through a pipe which conveys it to pockets. From these pockets the three main crankshaft bearings are fed direct. Branches from this pipe also deliver to four troughs immediately under the big ends, the latter being fitted with scoops. The troughs are so fitted that the level of oil therein can be altered by a quadrant lever on the dashboard, which opens and closes a sort of sluice gate, so that the amount of oil sprayed on to the cylinder walls can be adjusted with considerable nicety.

Charron.

Great simplicity and a variable feed are characteristics of this system. Oil is contained in a tank placed behind the water tank and the radiator on the front of the dashboard and feeds to the base chamber through a sight feed indicator which allows the flow to be adjusted by means of a ratchet thumbscrew. A second control of the oil supply is obtained by interconnecting the movement of the accelerator pedal with a valve attached to the sight feed. When the throttle is opened an additional supply of oil is therefore given to the engine. The oil is circulated entirely by gravity and splash.

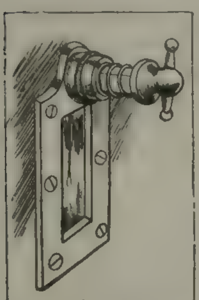


Fig. 8.—The Charron drip-feed and regulating valve.

Cadillac.

The floor of the crank chamber is formed with troughs into which dip short curved pipes attached to the big end bearings. The crank chamber is divided into four separate compartments, furnished with sloping gutters at the sides, and these gutters distribute the oil from one compartment to the other, so that the possibility of oil collecting at one end of the crank chamber is prevented if the car should stand on a pronounced incline. The oil reservoir is carried on the side of the crank chamber, and is fed by a double-acting pump driven by the magneto driving shaft. Oil is sent to the main bearings, gudgeon pins, and cylinder bearings by splash, the pump serving to provide a constant supply of lubricant in the abovementioned trough.

Darracq.

The lower half of the crank case with its sloping bottom serves as an oil reservoir, having at its lower part a gear pump which can easily be removed from outside. This pump, driven by means of a worm gear from off the camshaft, is constantly immersed in oil. It drives the oil through a main branch pipe into four narrow troughs bridging the bottom of the crank case. At each revolution of the crankshaft, scoops on the connecting rod dip into a trough and splash the oil wherever it is necessary. The main bearings have troughs cast over them, fed by this splash, and a further branch type delivers oil directly to the camshaft chain wheel, keeping full the bath in which the chains run. This system does away entirely with the necessity for a gauge on the dashboard. The oil base carries a filler with strainer and a level cock with the handle placed in an accessible position. To replenish, it is only necessary to pour the oil into the filler until it commences to run out of the level cock, which is open for filling and closed for running. A drain plug is fitted to the bottom of the crank case so that the engine may be easily cleaned.

Daimler.

Immediately over the sump, which contains a large supply of oil, are a series of troughs, and into these dip the scooped big ends, which splash oil to the sleeve valves, valve actuating shaft, and gudgeon pins, cylinder walls, and main shaft, the bearings of the latter being provided with cups to ensure a full supply of lubrication. The troughs are supported on shackles, by means of which they are raised and lowered, and as this movement is interconnected with the throttle lever a supply of oil is given proportional to the opening of the throttle. The troughs are supplied by a direct act-

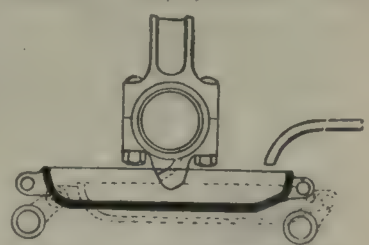


Fig. 9.—The arrangement of the Daimler adjustable troughs.

ing plunger pump of the multiple type, the five pistons of which are simultaneously operated by a connecting rod working from an extension of the valve actuating-shaft. A second connecting rod works a rocking valve, common to all the pumps, and regulates their function and delivery. Four of the pumps deliver direct to the troughs, which they keep completely filled with oil. The excess, and that which is splashed, returns to the sump through a filter. The fifth pump delivers to a sight feed gauge on the dashboard, which indicates the correct working of the system. The arrangement is, of course, quite independent of the gradient upon which the car stands. An exactly similar system is used on the Knight engines on the Siddeley - Deasy, the B.S.A., and Minerva cars. In the new 20 h.p. Special Daimler the supply of oil to the main bearings of the crankshaft is not affected by the throttle setting, but is maintained at its full volume under all conditions. The system is also slightly different from that described above, inasmuch as there is mounted on the side of the crank chamber a device whereby the oil circulation may be readily inspected and the quality of the oil easily examined whilst the circulation is proceeding. This consists of a small tap which, when turned on while the engine is running, ejects a stream of oil into a small cup which returns it to the sump. The colour of the oil can at once be seen, and the necessity for replenishment perceived.

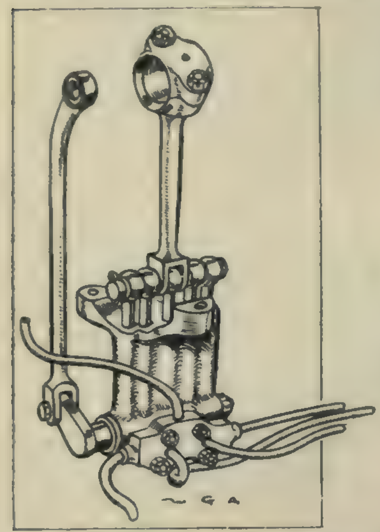


Fig. 10.—The Daimler multiple plunger pump. The short lever with a long connecting rod on the left regulates the suction and delivery.

Ford.

This system is notable for its extreme simplicity, as no additional working parts whatever are required in the design of the engine. Oil is filled into the housing which covers the flywheel and the low tension magneto. On the upper side of this housing is a cup which collects the oil thrown into it by centrifugal force and delivers it by gravity to the main bearings, whence it falls into the crank chamber, in which are cast transverse troughs immediately under the big ends. Oil so collected is splashed up to all reciprocating parts. The same system is used to lubricate the epicyclic gear, timing gear, and back axle. The magnitude of the oil flow depends upon engine speed.

Le Gui.

The oil supply is carried in a tank supported on the dashboard, which also contains a direct acting plunger pump. This is operated by a push rod worked by an eccentric on the camshaft, the actual working of the pump plunger being carried out by a rocking cam and the plunger being returned by a spring. On leaving the pump the oil passes through a visible drip feed and thence to the base chamber, where all working parts are lubricated by splash. The supply of oil is controlled by shortening or lengthening the stroke of the pump, which can be set to a stop.

Hudson.

A constant level of oil is maintained in the crank chamber by means of a positive pump driven by a special cam on the camshaft. The base chamber is divided by transverse walls which ensure an even supply of oil being splashed on to all working parts by the connecting rods. Any excess delivered by the pump is drained through a filter to the sump in which the supply of lubricating oil is carried.

Panhard.

The engine of this car is fitted with a very neat, ingenious and quite individual system of lubrication. The crank chamber is divided into four separate compartments, each of which supplies to one big end, and consists of a trough which contains oil which is splashed over the cylinder walls and main bearings. On returning it falls into a sloping channel, which conveys it to the next compartment, and thence it passes through another channel to the next and so on, the oil of the last compartment being splashed up on to a channel, which returns it to the oil reservoir cast on to the side of the crank chamber. It then returns to the first trough again through a small hole which is of such a size as to give an adequate circulation for slow running. The oil circulation can be inspected by undoing the filler cap, when the flow of oil can be seen. When the accelerator pedal is depressed the same movement communicates motion to a needle valve in the oil container, and, drawing it off its seat, allows an additional supply of oil to be put into circulation, so that the lubrication is proportional to throttle opening above a certain limit.

On the new 28 h.p. sleeve valve Panhard chassis, the carburetter is governed by two accelerator pedals, and when the main accelerator pedal is in operation this furnishes an additional oil supply to the engine when running at high speed. This supplementary supply is drawn from a tank placed in the chassis frame, whilst the ordinary oil reservoir, combined with the crank chamber, furnishes the oil at slow or normal speed. A mechanical pump of the usual type is employed.

Studebaker.

Engine lubrication is effected by means of a plunger pump driven direct from the camshaft. A supply of oil is carried in the sump at the bottom of the crank case; from here the pump forces it into four troughs, one under each connecting rod. The remainder passes to a gauge glass on the dashboard, from which the oil is led to the timing gears in the front of the engine. This gauge serves as an indication that the pump is working correctly. There is an oil level indicator fitted to the side of the crank case, which is easily visible and shows accurately at all times the quantity of oil in the sump. Oil ducts are carried to the crankshaft bearings, other parts being lubricated by splash.

Vulcan.

In the 10-15 h.p. and 15.9 h.p. cars, oil contained in the sump is directed by a rotary gear pump through a tell-tale of the piston type on the dashboard, whence it descends to a manifold, which serves troughs under each of the big ends and also the timing gear. The connecting rods are furnished with large scoops. The supply of oil to the main bearings, cylinder walls, and gudgeon pins is by direct splash. The oil ultimately drains back into the sump and is filtered before being used again. On the 15-20 h.p. model the arrangement is somewhat different, as oil is forced direct to the crankshaft journals and big end bearings through the hollow crank pins and webs, being splashed on to the other moving parts. A pressure gauge is mounted on the dash.

Springing Systems.

A Review of Some Present Day Forms of Car Suspension for Front and Rear Axles, and their Merits or Demerits.

IT is sometimes said, and with a certain amount of justice, that most cars of to-day are alike except for small detail differences which the designers seize upon in order to exhibit their characteristic individualities. To the man in the street this statement contains a large amount of truth, but those who take more interest in technical affairs realise that quite frequently small details in construction are the outward and visible signs of a wide difference in principle. So far as the general lay-out of a chassis is concerned, although we have not reached any stage that is entitled to be called finality, we have certainly got to one in which it is possible to say that the general arrangement of nearly all cars is alike. For instance, engines and gear boxes of practically all cars exhibit a strong family likeness, and if one had them removed from the chassis and all sorts of makes put together, it would be a clever man who could call each one by its right name. Braking systems are also "much of a muchness," with one or two notable exceptions.

There are, however, two very important features of car design in which a very great disparity of opinion is manifest, and it is almost a case of "*Quot homines, tot sententiæ.*" These are the suspension and the transmission. With regard to the former, the present article has for its object to show what a large number of different principles are employed in prominent cars at the present day. It is intended not to be a disquisition on the theory of springing, but simply a review of current practice. On account of the close connection, however, between suspension and transmission, it has been found inadvisable to attempt to separate the two, and therefore in this article both systems are reviewed together.

Fig. 1.—The Lanchester or cantilever type front spring.
A, trunnion. B B, slides.


Fig. 2.—The Waverley compound quarter-elliptic front spring.

Fig. 3.—The type of half-elliptic front spring extensively used.
A is the approximate centre of the arc through which the axle oscillates.
B is the centre of the arc through which the steering rod oscillates.

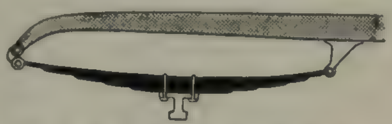


Fig. 4.—A De Dion front spring with a shackle at the forward end.

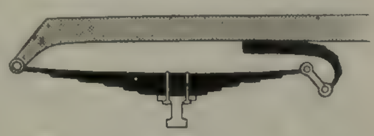


Fig. 5.—The threequarter elliptic front spring used on the London General Omnibuses.


Fig. 6.—The transverse spring on the front axle of the Ford car.

Front Axle Suspension.

The suspension of the front part of the chassis will be considered first. In general, it is not unfair to say that the importance of the front springs is grossly under-rated by most manufacturers. True, they are not so relatively important as the back, since the centre of gravity of the passengers is far nearer the rear wheels than the front, but, at the same time, there is no reason why so much of the attention in the consideration of suspension should be devoted to the rear and so little to the front. The front springs may be considered to be of more importance to the driver than to the passengers, on account of the very pronounced effect which they have upon the steering of the car. If it is important that the back tyres should be kept in constant contact with the road surface, it is equally necessary that the same should apply to the front tyres.

There are practically no steering gears which are really irreversible. They may be actually so, or nearly so, when the car is standing stationary, but in a state of vibration, such as is caused by a rapid succession of small road shocks transmitted through the front wheels, the apparent irreversibility frequently vanishes. The same phenomenon is observable on ships in which the rudder is controlled through a worm and wheel device similar to that used in the steering box of a car, although the pitch of the worm is very much smaller than is used on any car. It is found that the rudder not only can, but does, manage to reverse the action of steering, although if the boat were in dry dock it is quite probable that, however hard one tried to push the rudder over, the gear would be found irreversible. It very frequently happens that one front tyre is completely out of contact with the road surface, whilst the other strikes a small obstacle which tends to deflect it, or possibly causes it also to leave the road surface. In this case steering becomes a very difficult matter to perform to a nicety, and, so far as the writer's knowledge goes, there are very few cars indeed at the present day which steer as well at a high speed over rough roads as they do at a low speed, unless suitable shock absorbers are fitted. Yet passengers in the same car will enjoy just as much comfort in the one circumstance as in the other.

The chief reason why the front springs are generally only moderate instead of being good is that it is not possible to make them of sufficient length. For equal roads, the longer the spring the greater the flexibility or range of deflection through which it can pass. Consequently, since front springs are inclined to be short, they show a tendency to be rather hard and generally too lively. Where a longitudinal half elliptic spring is used, it is not easy to see how this difficulty can be overcome, as one does not want to have the dumb iron extensions of the channel steel frame projecting a considerable distance in front of the periphery of the wheels, and, this being so, it is rather surprising that more attention has not been given by motor car manufacturers to the claims of the cantilever or Lanchester type of front spring (shown in fig. 1), which, of course, demands no dumb iron in the usual sense of the term.

Springing Systems.

The types of spring commonly used for the front axle are five in number:

(1.) The quarter elliptic or grasshopper.
(2.) The half elliptic.
(3.) The threequarter elliptic.
(4.) The transverse.
(5.) The helical.

Of these the half elliptic enjoys an immense preponderance numerically. Whether it will continue to do so, however, is open to some doubt, especially as the Americans have shown how serviceable and satisfactory a proper design of transverse spring can be.

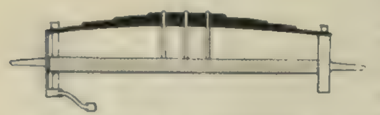


Fig. 7.—System of front-springing used on the earlier type of Sizaire-Naudin car.

The Lanchester or cantilever type is shown in fig. 1. Ball jointed radius rods are arranged above and below the spring, so that the axle has a parallel motion. (See figs. 11 and 12.)

Fig. 2 illustrates the Waverley (old type), which employs two quarter elliptic springs, and therefore requires no slides or shackles. The demand for a larger body space on this car has now led to the use of half elliptic springs.

Fig. 3 shows the standard type of half elliptic spring as used on at least 90% of cars. The spring is eyed to the dumb iron in front and shackled behind, and, as will be perceived, the axle, therefore, under road shock oscillates up and down in a small arc approximately represented by a part of a circle described about the point A. Now, the steering thrust rod, which connects the steering box crank to the stub axle pivot, is centred at the point B, and in consequence of this the forward end of the connecting rod tends to swing in a circle about B. If, therefore, the spring is deflected, lost motion must occur at some point, and as both A and B may be considered immovable, the deflection of the spring is accompanied by the steering wheels turning slightly one way or the other on their pivots. As a rule, the amount of wheel deflection which thus takes place is practically negligible. But it may be cited as one reason at least why the front springs should be made on the hard side. In the older De Dion cars the arrangement of the front spring is the exact reverse of that shown in fig. 3, as it is eyed at its rear end and shackled at its front. In this case, therefore, the amount of lost motion and consequent deflection of the front wheels was very much slighter than in the previous case, since the two circles had their centres much closer together. Consequently, the two arcs were of similar, though not necessarily coincident, curvature. (Fig. 4.)

Fig. 8.—The Calthorpe quarter-elliptic rear spring.

Fig. 9.—The G.W.K. quarter-elliptic rear spring.

In the Argyll car, the employment of the front wheel brakes renders the use of a torque rod to take the thrust of these brakes desirable. As this torque rod also serves the purpose of a radius rod, the springs are practically shackled at both ends. In point of fact, the front shackle takes the form of a slide which answers the same purpose and presents a much neater appearance.

The threequarter elliptic front spring (fig. 5) is, in so far as the writer is aware, employed on no pleasure cars at all, but, as it is used on many thousands of the 'buses belonging to the London General Omnibus Co., it is at least worthy of illustration. There does not appear to be any reason whatever why this form of spring should not be more largely used, as it possesses certain distinct advantages. The small quarter elliptic might be modified to form practically a subsidiary shock absorber, considerably weaker than the lower half of the spring; the front portion of the latter would therefore simply serve as a radius rod.

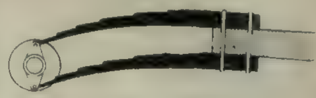


Fig. 10.—The Waverley rear spring.

Although the transverse type of spring is fitted nowadays to few but American cars, it was used in the very earliest days. The 70 h.p. Panhard on which Jarrott won the Circuit des Ardennes was one of the more notable machines that employed this form of suspension. To-day it is principally associated with the Ford car, the arrangement of the spring in this case being shown in fig. 6. The front axle is held in position by two converging radius rods, which meet at a point about the centre of the chassis, where they terminate in a ball joint. By this means the axle is prevented from sliding from side to side, as the double shackling of the spring would otherwise allow it to do. By fixing the pivot of the radius rod at or about the normal centre of the steering connecting bar, the swivelling tendency of the front wheels in passing over bad roads, as previously mentioned, is almost entirely done away with.

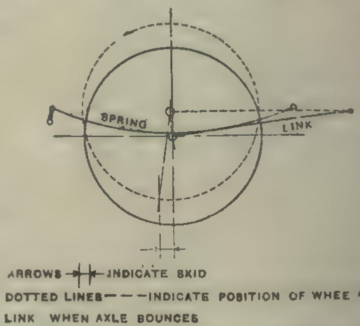


Fig. 11.—A diagram showing the movement of a wheel caused when the axle is thrown upwards with the ordinary type of rear spring.

In the earlier pattern Sizaire-Naudin no front axle of the ordinary type is used; instead, the stub axles are carried on vertical slides in the form of boxes, which abut against the extremities of the spring, as shown in the sketch fig. 7.

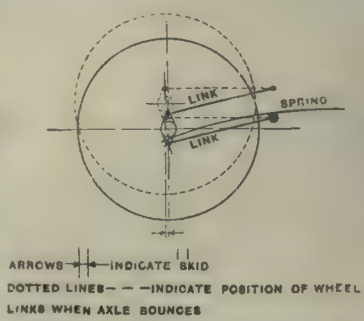


Fig. 12.—Movement of the wheel when the axle is thrown upwards in the Lanchester system of springing with parallel radius rods.

In light cars, the small weight of the vehicle makes the use of undamped helical springs feasible, but in larger-sized cars, although they were once fairly often used, they are very much the exception nowadays, owing, of course, to the fact that, if undamped, these springs will merely act as "bouncers."

Rear Springing.

The types of rear spring in use are as follow:

(1.) Quarter elliptic or "grasshopper."
(2.) Compound flat.
(3.) Half elliptic.
(4.) Threequarter elliptic.
(5.) Full elliptic.
(6.) Transverse.
(7.) Combined longitudinal and transverse.

Quarter elliptic springs are apparently growing in popularity. One instance of their use is to be found in the Calthorpe (fig. 8). In this case the spring, in addition to its suspensory functions, takes the drive and acts as a radius rod. The axle is free to revolve in the rear eye of the spring, and the torque is taken by the tube which encloses the propeller-shaft.

On the G.W.K. (fig. 9) a somewhat similar arrangement is used, but the axle is rigidly fixed to the spring, which, therefore, takes both the torque and the drive. It is a moot point as to whether the principle of making the spring serve any other purpose but that of providing suspension is good practice; theoretically it is not so. Thus, a radius rod should be a perfectly rigid member, which a spring is not. Again, if used as a torque rod the spring is subjected to stresses quite different from those imposed by carrying a road vehicle. In actual practice, however, this principle of doubling or trebling the duties of the spring works perfectly well.

In the Waverley car (fig. 10), as in the G.W.K., the springs again are used as torque and radius rods, but there is an important difference between these two systems. From figs. 8 and 9 it will be realised that the axle, under road shock, moves in an arc approximately part of a circle described about the point of anchorage of the spring. In the Waverley the axle has a parallel motion.

The importance of this point is shown in figs. 11 and 12, which refer particularly to the Lanchester spring system. The former shows what happens to the tyre on the road in the ordinary suspension, and the latter what happens when a parallel suspension is used. It should be pointed out that the parallel principle owes its inception to the Lanchester car, on the earliest models of which it was incorporated. Fig. 11 shows how, if the spring be deflected upwards, the point of contact between the road and the wheel changes, and, in consequence, a slip between the tyre and the road surface occurs. This slip, it may be observed, is equal to about half the distance which the axle moves upwards (and, of course, depends on the length of the radius rod or link). In the parallel system the axle, though moved upwards, does not tend to turn on its own axis, and consequently the amount of deflection at the point of contact with the road is very much smaller. This is shown in fig. 12. It need hardly be said that the effect of this system upon the tyre wear is exceedingly beneficial, for tyre slip must always result in unduly rapid wear.

The original Lanchester system, which may be described quite fairly as the pioneer of good springing, and is one of the best that has ever been devised from the point of view of comfort, has been in use now unchanged for many years. It employs, as shown in fig. 13, a compound type of spring. This may be described as a cantilever. The bracket A to which it is fixed is attached to the frame by means of a trunnion, whilst at either end the spring rests upon lubricated slides. An upward road shock therefore tends to turn the rear extremities of the spring upwards, and the front extremity downwards, as shown in an exaggerated form by the dotted line. This movement occasions the greatest possible flexion of the spring, which is accompanied by a large differential movement between the leaves or plates of which it is composed. With a given number of leaves, and of a given length, the frictional damping effect of such a spring is greater, therefore, than it would be if it were used as a half elliptic in the ordinary way.

In the Lanchester car the spring has nothing to do with either the torque or the drive, but merely carries the load of the car. A parallel motion is given to the back axle by means of two pivot links, one above and the other below the spring. The lower link is of definite length, but the upper one is provided at its forward end with a rubber buffer, which, therefore, provides progressive resistance against the torque effect. The same system is also used in the Siddeley-Deasy car.

The Rolls-Royce system of springing, as used on their London-Edinburgh models, is illustrated

Fig. 13.—The Lanchester rear spring which is attached to the frame at its centre by the trunnion A.

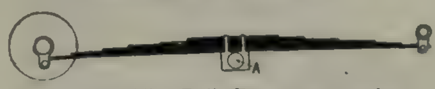


Fig. 14.—The Rolls-Royce rear spring. This is secured to the frame above a trunnion A.

Fig. 15. — The Sheffield-Simplex rear spring, secured to the frame below a trunnion A.

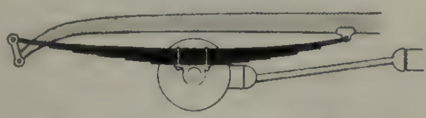


Fig. 16.—The type of half-elliptic rear springing which displaces both torque and radius members.

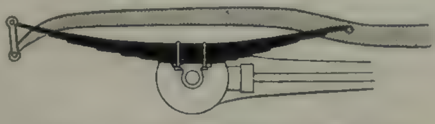


Fig. 17.—The Vauxhall half-elliptic rear spring. A separate member is provided to take the torque.

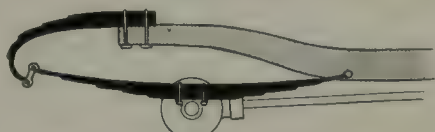


Fig. 18.—The Hurtu threequarter elliptic rear spring, taking both drive and torque.

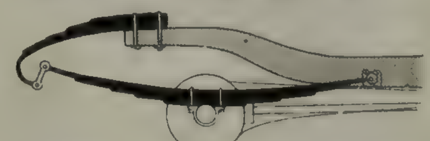


Fig. 19.—The Lancia threequarter elliptic rear spring. A separate torque member is provided.

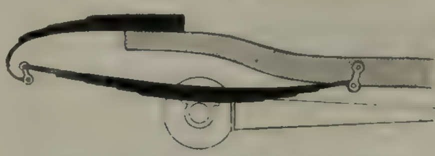


Fig. 20.—The Argyll threequarter elliptic rear spring which is shackled at the front end. The casing of the propeller-shaft takes both torque and thrust.

Springing Systems.

diagrammatically in fig. 14. The disposition of the spring is in this case precisely as in the Lanchester, and here again it has nothing but suspensory work to perform. The central platform of the spring is trunnioned to the frame, and rollers are provided at each end so that the extremities can slide. The torque and the drive are taken by a spherically-ended tube which encloses the propeller-shaft, not shown in the sketch.

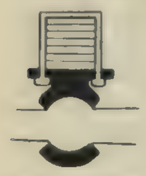


Fig. 21.—The spherical bearing of the spring pads of the Charron car.

The Sheffield-Simplex principle is the same as the Rolls-Royce, except that the trunnion pin, instead of being below the spring, is above it, as shown in fig. 15.

Half elliptic springs are fitted to a considerable number of cars, although perhaps not to so many as formerly. Two principles are in vogue, which may be illustrated by the Straker-Squire (fig. 16) and the Vauxhall (fig. 17). In the first case the axle is rigidly attached to the spring, and the propeller-shaft is therefore fitted with universal joints both top and bottom. In the second case the axle is swivelled in the spring brackets, and a separate torque member is used. In both cases the drive is taken through the front portion of the spring.

Fig. 22.—The Arrol-Johnston full elliptic rear spring.

A very popular type of rear springing is the threequarter elliptic, which is applied in almost every possible form. In most cases its function is purely suspensory; in others it takes the torque and not the drive; in others again it takes the drive and not the torque, and in others it takes both. In the Hurtu (fig. 18) both drive and torque are taken by the spring. The cardan-shaft is universally jointed at each end.

In the Lancia the spring takes the drive, but a separate torque member is provided. Here again double universal joints embodying also a telescopic joint are used.

Fig. 23.—The Studebaker full elliptic rear spring.

In the Argyll (fig. 20) a single universal joint on the head of the propeller-shaft is used, the casing of which takes both drive and torque. Here it will be observed that the lower half of the spring is shackled at both ends. In the Benz a similar arrangement is used, except that separate radius and torque rods are used.

Fig. 24.—The arrangement of the rear spring on the Austin car. The front ends are fixed to the chassis frame at A, and the upper spring is carried in a trunnion, B.

In some cars, notably the Charron, the lower half of the threequarter elliptic spring is attached to the axle by means of a spherical joint, as shown in fig. 21. This allows the spring at one side to be deflected more than at the other side, without imposing any lateral stress on the leaves.

The principal advantage of the full elliptic spring is that the same frictional surface between the leaves and the same amount of deflection can be incorporated in a spring which takes the smallest possible amount of room. Full elliptic springs can be arranged in many different ways, and the particulars of three are given. Fig. 22 illustrates the Arrol-Johnston spring. Here both springs work strictly as one, their eyes being mounted concentrically on the same pins fore and aft. They are in this car relieved from both driving strain and torque.

Fig. 25.—The transverse rear spring on the Ford car.

In the Studebaker the spring is arranged as shown in fig. 23, and is used to convey the drive, the torque being supported by a separate member. In the Austin the full elliptic spring really consists of a half elliptic applied to a compound spring. There is no connection between the front eyes of the upper and lower springs, both of which are supported directly by the side member of the chassis. The load on the rear extremity of the upper part of the spring is taken by the flexion of the whole of the upper part, as it is supported in a box which is swivelled to the chassis. Both the drive and the torque are separately accommodated.

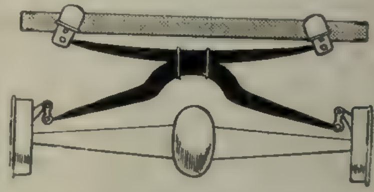


Fig. 26.—The transverse springing of an Alda car.

The Ford transverse spring arrangement, as shown in fig. 25, is almost exactly similar to the front spring already described. A similar system, though more elaborate, is used on the Alda car. This is shown in fig. 26. It will be observed that the main transverse spring is supported by an upper inverted transverse spring, at the extremities of which are attached multiple spring shock absorbers. It would not be difficult to prophesy that rolling may be liable to occur.

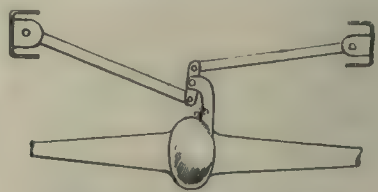


Fig. 27.—The system of links employed with the Arrol-Johnston rear spring to prevent rolling.

In one car this undesirable attribute, *i.e.*, rolling, which is common to a certain extent to all forms of springing, has been adequately provided against, viz., the Arrol-Johnston. In this case a simple link motion, connecting the chassis members with the back axle, is employed to ensure that the two always remain parallel to one another.

A transverse rear spring in conjunction with longitudinal half elliptic springs (fig. 28) was at one time a very favourite form of suspension, though now rarely used, owing, no doubt, to the rolling tendency. Inasmuch, however, as it provides a form of three-point suspension, it is possessed of certain claims to consideration. Amongst those cars which use this system are the Niclausse and the Colonial Napier.

Fig. 28.—Semi-elliptic longitudinal rear springs combined with a transverse spring.

W.G.A.

The Imperial Motor Transport Conference,

and the Permanent Council which has resulted from it.

NOW that the thing has been done, it is a matter of surprise that no general conference of those interested in the encouragement of the motor movement had been held in any country prior to 1913. The nearest approach to any organisation of the kind before this date was a conference of a national character held in France, and devoting itself entirely to public passenger motor services. The proposal to hold an Imperial Conference in London during the summer of last year was only made about six months previously, and consequently the time available for organisation was very short. Fortunately, however, the idea was so promptly approved both by the Society of Motor Manufacturers and Traders, and also by the Hon. Arthur Stanley, M.P., Chairman of the Royal Automobile Club—and evidently the ideal chairman for a gathering of this kind—that in the event it proved possible to bring together at short notice upwards of two hundred delegates representative of a great variety of interests in all parts of the Empire.

The Conference Committee.

An Executive Committee was formed early in 1913. under the chairmanship of the Hon. Arthur Stanley, supported by other well-known members of the R.A.C., and the other motoring organisations, and by a strong representation of the Trade Society. This Committee was also greatly strengthened by the inclusion of a number of the consulting engineers attached to the London offices of the Governments of the self-governing Dominions and their States and Provinces, and representatives of the Colonial Office and of the office of the Crown Agents for the Colonies.

The success of the work undertaken by this Committee was very greatly facilitated when H.R.H. Prince Arthur of Connaught, K.G., consented to become president of the organisation, while the list of vice-presidents grew to include the names of the High Commissioners of the four self-governing dominions and five members of the British Cabinet, namely, the Secretary of State for the Colonies, the Secretary of State for War, the Secretary of State for India, the Postmaster-General, and the President of the Board of Trade. Mr. Horace Wyatt, consulting editor of *Motor Traction*, was appointed honorary secretary of the Conference Committee, being assisted in the organising work by Mr. David Bell, assistant editor of *Motor Traction*, and Colonel C. C. Townsend, R.A.

The response to the invitations of the Committee was extremely satisfactory, not only in respect of the numbers of the delegates appointed to attend the Conference, but also as regards the very representative nature of the organisations which associated themselves with the movement. Thus, to take one example, the delegates representative of interests within the Indian Empire included nominees of the India Office, the Government Railways of India, the Government of India in the Army Department, the Department of Posts and Telegraphs, the Chambers of Commerce of Bombay, Bengal, Upper India, Madras, and Burmah; the Indian Mining Association, the Corporations of Madras and Bombay, the Great Indian Peninsula Railway, the Railway Board of India, the East India Railway, the Bengal-Nagpur Railway, the Indian Merchants Chamber and Bureau, and various other bodies.

The Conference Meetings.

The meetings of the Conference were timed to take place concurrently with the Exhibition of Industrial Motor Vehicles at Olympia (July, 1913), organised by the Society of Motor Manufacturers and Traders. Of the three sessions of the Conference, the first two were held at Olympia, and the third at the Royal Automobile Club. The first gathering was inaugurated by the Right Hon. the Marquess of Crewe, K.G., Secretary of State for India, who pointed out that those present were assisting as great a revolution as was brought about by the invention of printing, by the discovery of the applicability of steam to railway or shipping transport, or by the invention of the electric telegraph.

At the conclusion of Lord Crewe's speech, the Hon. Arthur Stanley took the chair, and the meeting addressed itself to a consideration of the fuel question. A very valuable statement was contributed by Sir Boverton Redwood, Bart., and Professor Vivian B. Lewes (this paper being printed in full elsewhere in this publication), while a comprehensive monograph on the supply of hydro-carbon fuels was submitted by Mr. W. J. A. Butterfield. The overseas delegates took a very prominent part in the discussion which followed the submission of these papers, and the general view was clearly very much in accord with the conclusion reached by Sir Boverton Redwood and Professor Lewes, to the effect that the only permanent solution of the difficulty lies in the adoption of alcohol as a fuel. Mr. Oscar E. G. Evans, representing the South African Agricultural Union, moved a resolution which was passed unanimously, to the effect that the Conference was agreed that steps should be taken to secure thorough investigation of alcohol as a substitute for petrol, and that a committee should be appointed to consider ways and means, and to report to the Conference. It will be best to turn for a moment from this subject before referring to the recommendations of this Urgency Committee on the fuel question.

At its second meeting the Conference devoted attention mainly to the question of the supply of vehicles suitable for military purposes, and a consideration of how far army requirements could be brought into line with the needs of commercial users in the Colonies, and what steps could be taken to ensure closer relations between British manufacturers and buyers overseas.

Papers were submitted by Colonel H. C. L. Holden, C.B., F.R.S., Captain A. E. Davidson, R.E., Colonel R. E. Crompton, C.B., Captain R. K. Bagnall-Wild, R.E., Mr. Horace Wyatt, Mr. G. Hamilton Grapes (representing the Postmaster-General of New Zealand), and Mr. W. W. Hoy, General Manager of the South African Government Railways. Among those who took part in the discussion were Mr. L. J. Beirne, Secretary of the Canadian Chamber of Commerce in London, Colonel Ewart (India Office), Mr. G. C. S. Hodgson (Ceylon), Colonel Robin (New Zealand), Mr. S. M. Johnson (India), the Right Hon. Sir John Macdonald, and Mr. R. L. Drury (British Columbia). Mr. H. G. Humby (South Africa) gave notice that at the next meeting he would move a resolution for the purpose of providing machinery for carrying out the proposals which had clearly commended themselves to the delegates, his suggestion being the formation

The Imperial Motor Transport Conference.

of a permanent Council in London based upon the Executive Committee of the Conference, and representative of all recognised interests connected with the manufacture and use of motor vehicles in Great Britain, together with members representative of the Empire overseas, and of the offices of the various Dominions and Colonies in London.

The Urgency Committee to consider the Fuel Question held a meeting, under the chairmanship of the Hon. Arthur Stanley, prior to the third session of the Conference. The Committee, which included representatives from India, Ceylon, Canada, Australia, New Zealand, South Africa, Nyasaland, and Great Britain, advised that a Standing Committee should be formed in London to collect data with regard to the use of alcohol as a motor fuel, this Standing Committee to be in communication with representatives in various parts of the Empire. It further strongly recommended the Conference to support Mr. Humby's resolution, adding the suggestion that the permanent Council, if formed, should be asked to constitute an Alcohol Motor Fuel Committee.

At the third session of the Conference, held at the Royal Automobile Club, attention was given to a variety of questions relating to the carriage of goods and passengers by road. Papers were submitted by Mr. W. Worby Beaumont, Mr. W. Tetley Stephenson, Mr. E. A. Greathed, Mr. Walter G. Gates (Assistant Secretary of the Post Office), Mr. G. Hamilton Grapes, and Mr. P. Ellison.

Subsequently, the report of the Urgency Committee on Alcohol Fuel was submitted and accepted, Mr. Humby's resolution having previously been passed unanimously. Thus, at the conclusion of the Conference, the position was that the original Organising Committee was pledged to form itself into a permanent Council, empowered to form from time to time special expert committees to deal with matters of importance, and definitely instructed to set about the formation of such a committee for the purpose of investigating the possibilities of alcohol.

Incidentally, it may be mentioned that the work of the Conference itself was not limited to the submission of papers and subsequent discussions. The delegates were given ample opportunity of examining the exhibits at the Olympia Show, and parties visited the headquarters of the London Fire Brigade, the garage of one of the principal motor cab companies, one of the many garages of the London General Omnibus Company, and a depot from which a large number of motor mail vans are operated. A trip was made to Windsor Castle by motor omnibus, and the programme of entertainment also included a garden party at the Royal Botanical Gardens, at which the delegates were received by Their Highnesses the Duke and Duchess of Teck, and a reception at the Royal Automobile Club.

The proceedings of the Conference were subsequently published in book form under the title of "Motor Transport and the Empire." Copies of this publication can be obtained from the Hon. Secretary of the Imperial Motor Transport Council, Royal Automobile Club, Pall Mall, London, S.W., for 4s. post free.

In accordance with the instructions of the Conference delegates, the Executive Committee of the organisation subsequently met and constituted itself into a permanent Council, adding to itself several new members with a view to making the Council as thoroughly representative as possible. The following is a complete list of the officials and members of the Council, but the late Lord Strathcona and the late Sir Richard Solomon were also included in the original list of vice-presidents.

President:

H.R.H. Prince Arthur of Connaught, K.G.

Vice-presidents:

The Rt. Hon. Lewis Harcourt, M.P., Secretary of State for the Colonies.
Col. the Rt. Hon. J. B. Seely, M.P., Secretary of State for War.
The Rt. Hon. The Marquess of Crewe, K.G., Secretary of State for India.
The Rt. Hon. Herbert Samuel, M.P., Postmaster-General.
The Rt. Hon. Sydney Buxton, M.P., President of the Board of Trade.
The Rt. Hon. Sir George Reid, G.C.M.G., High Commissioner for the Commonwealth of Australia.
The Hon. Thomas Mackenzie, High Commissioner for the Dominion of New Zealand.

Members of Council:

Chairman: The Hon. Arthur Stanley, M.P., M.V.O., Chairman of the Royal Automobile Club.
Mr. W. Worby Beaumont, M.Inst.C.E., Consulting Engineer to the Chief Commissioner of Police.
Lieut.-Col. W. G. B. Boyce, D.S.O., Chairman, Mechanical Transport Technical Committee. Nominated by the Army Council.
Mr. F. Coates, Consulting Engineer to the Commonwealth of Australia and the Government of Victoria.
Col. R. E. B. Crompton, C.B., Consulting Engineer to the Road Board, and Chairman of the Commercial Motor Users' Association.
Capt. A. E. Davidson, R.E., Secretary, Mechanical Transport Technical Committee. Nominated by the Army Council.
Mr. J. Duncan Elliot, of Messrs. Carruthers and Elliot, Consulting Engineers to the Dominion of New Zealand.
Col. R. H. Ewart, C.I.E., D.S.O., A.D.C. Nominated by the Secretary of State for India.
Mr. Walter G. Gates, Assistant Secretary of the Post Office. Nominated by the Postmaster-General.
Mr. Richard M. Greaves, Chairman of the Implement Committee of the Royal Agricultural Society of England.
Mr. W. L. Griffith, Permanent Secretary to the High Commissioner for Canada.
Mr. Wm. Harvey, Engineer to the Tasmanian Government.
Mr. Ashton M. Heath, Chief Inspecting Engineer to the Crown Agents for the Colonies.
Mr. W. Joynson Hicks, M.P., Chairman of the Automobile Association and Motor Union.
Col. H. C. L. Holden, R.A., C.B., F.R.S., ex-Chairman of the Royal Automobile Club.
Mr. John Howard, Agent-General for Nova Scotia.
Mr. H. G. Humby, Consulting Engineer to the Union of South Africa.
The Hon. Andrew A. Kirkpatrick, Agent-General for South Australia.
Major-General F. W. B. Landon, C.B., Director of Transport. Nominated by the Army Council.
The Rt. Hon. Sir John H. A. Macdonald, K.C.B., President of the Scottish Automobile Club.
Mr. W. H. Mercer, C.M.G., Crown Agent for the Colonies. Nominated by the Secretary of State for the Colonies.
Sir Charles Metcalfe, Bart., Consulting Engineer to Rhodesia.
Lord Montagu of Beaulieu, Member of the Road Board, etc.
Col. the Hon. Sir N. J. Moore, K.C.M.G., Agent-General for Western Australia.
Mr. J. W. Orde, Secretary of the Royal Automobile Club.
Sir Thomas D. Pile, Bart., Director of the London General Omnibus Company.
Sir Boverton Redwood, Bart., D.Sc., F.R.S.E., etc., past President of the Society of Chemical Industries; Adviser on Petroleum to the Government.
Mr. E. Shrapnell-Smith, Hon. Treasurer of the Commercial Motor Users' Association.
Mr. James Tearoe, Executive Engineer to the Queensland Government.
The Hon. J. H. Turner, Agent-General for British Columbia.
Mr. H. E. Wimperis, Inspecting Engineer to the Crown Agents for the Colonies.

Representatives of the Society of Motor Manufacturers and Traders:

Mr. S. F. Edge, President of the Society of Motor Manufacturers and Traders.

Mr. E. MANVILLE, ex-President of the Society of Motor Manufacturers and Traders.
Mr. SIDNEY STRAKER, Chairman of the Commercial Vehicles Committee; Managing Director of Messrs. Sidney Straker and Squire, Ltd.
Mr. RAYMOND DENNIS, Managing Director of Messrs. Dennis Bros., Ltd.
Mr. F. CHURCHILL, Manager of the Automobile Department Messrs. J. and E. Hall, Ltd.
Mr. R. BARRY COLE, Sales Manager Messrs. Commercial Cars, Ltd.

Hon. Secretary:
Mr. HORACE WYATT.

At one of its earlier meetings the Council formed a small Technical Enquiries Sub-committee to deal with postal enquiries relating to the selection and operation of motor vehicles, and with kindred subjects. This sub-committee, which consists of Mr. W. Worby Beaumont (chairman), Mr. Ashton M. Heath, Mr. H. E. Wimperis, and Mr. Horace Wyatt, has already received and replied to a number of enquiries from various parts of the Empire.

More recently, the Council has considered and subsequently published a memorandum from Mr. L. J. Beirne, the Secretary of the Canadian Chamber of Commerce in London, containing proposals as to the best means of increasing the trade of British motor manufacturers in Canada.

The Alcohol Motor Fuel Committee.

Meanwhile, the work of forming the Alcohol Motor Fuel Committee was in progress. This committee was completed early in 1914 as follows:

Chairman: The Hon. ARTHUR STANLEY, M.P., M.V.O., Chairman of the Royal Automobile Club, etc.
Mr. THOS. L. AVELING, Member of the Council of the Royal Agricultural Society of England. Nominated by the Royal Agricultural Society.
Mr. BERTRAM BLOUNT, F.I.C., Consulting Chemist to the Crown Agents for the Colonies.
Mr. J. SIDNEY CRITCHLEY, M.I.Mech.E., M.I.A.E., President of the Institution of Automobile Engineers.

Mr. S. F. EDGE, President of the Society of Motor Manufacturers and Traders.
Mr. S. GLOVER, M.Inst.C.E., F.R.M.S., Gas Engineer to the Corporation of St. Helens.
Dr. H. S. HELE SHAW, D.Sc., LL.D., F.R.S., M.Inst.C.E., M.I.Mech.E., etc., formerly Chairman of the Motor Union Fuel Committee; past-President of the Institution of Automobile Engineers; Member of the Committee of the Royal Automobile Club. Representing the Automobile Association and Motor Union.
Mr. BASIL H. JOY, Secretary of the Institution of Automobile Engineers; formerly Manager of Messrs. Simpson, Strickland, and Co.; special representative of *The Engineer* for Diesel and other internal combustion engines. Representing with Mr. Critchley the Institution of Automobile Engineers.
Professor VIVIAN B. LEWES, F.I.C., F.C.S., Professor of Chemistry at the Royal Naval College, Greenwich; Vice-president of the Institute of Naval Architects.
Dr. W. R. ORMANDY, D.Sc., M.I.A.E., Bishop Berkely Fellow of Owen's College, Manchester, who has carried out important investigations on the use of alcohol and alcohol mixtures as a fuel for motor engines.
Sir BOVERTON REDWOOD, Bart., D.Sc., F.R.S.E., F.I.C., etc., etc., past-President of the Society of Chemical Industry; Adviser on Petroleum to the Government.
Mr. SIDNEY STRAKER, past-President of the Society of Motor Manufacturers and Traders; Chairman of the Commercial Vehicles Committee of the S.M.M. and T.
Mr. THOMAS TYRER, F.I.C., F.C.S., Member of the Departmental Committee on Industrial Alcohol, 1905; past-President of the Society of Chemical Industry; Member of the Council of the London Chamber of Commerce
Hon. Secretary: Mr. HORACE WYATT, B.A.

At the time of writing, this committee has just begun its investigations, the scope of which will be, of course, to a great extent dependent on the degree of financial support afforded to the committee. There is every prospect that this support will prove to be considerable and authoritative, in which case the committee should be able to do work and to bring about results of the greatest possible value to the motoring community throughout the world.

An Historic Tyre Test.

An item in last year's motoring circles which caused considerable comment and interest was the "unofficial" tyre test of the Victor tyres against three of the best known tyre covers on the market—the Dunlop, Continental, and Michelin. The last stage of the trial, which had been in progress since July, 1912, was reached on April 17th, 1913, when a meeting of the committee of private motorists supervising the test was held for the purpose of making the collective award. The Royal Automobile Club, it may be recalled, was originally asked to conduct the trial and at first consented to do so, but subsequently declined.

In the Grand Prix Race which was held on July 11th, 1913, Chassagne on a Sunbeam was third with an average speed of 70·3 m.p.h. The total distance was 570 miles, and Chassagne's time was 8h. 6m. 20½s. Our illustration depicts Chassagne taking the Moreuil corner, which is approached by a long descent succeeded by a rise necessitating a gear change.

All the tyres used covered a distance of about 15,000 miles, and were purchased for the committee by members thereof and quite unknown to the Victor Tyre Co. An unfortunate accident to the car, due to a skid, when the trial was nearing conclusion, occurred near the Devil's Punch Bowl on the Portsmouth Road; the occupants of the car were all thrown out and four of the five were badly injured; we are pleased to say that they have since fully recovered. At the time of the accident, the only tyres on the trial car were plain tread Victors, and at that time the aggregate mileage of the three Victors exceeded the aggregate mileage of the second competitor, the Dunlop, by about 400 miles.

Several speakers at this meeting referred to the fairness with which the test had been conducted and the open manner in which everything had been done, and the meeting passed a resolution unanimously awarding the premier award to the Victor tyre.

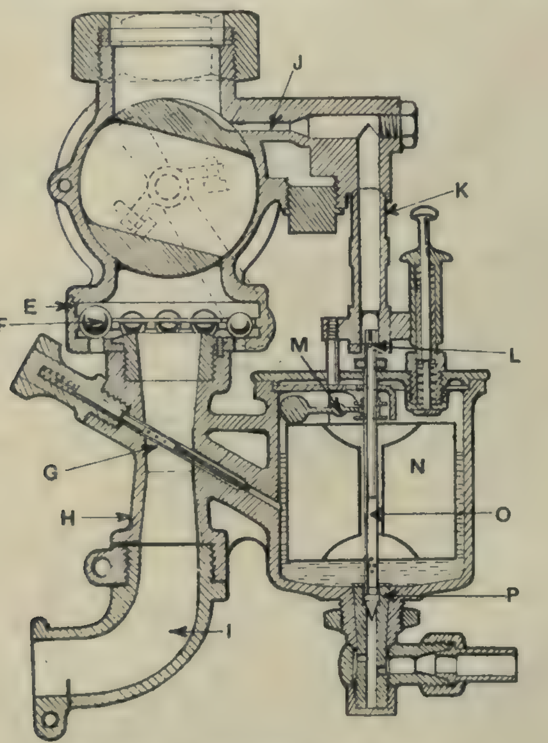
"Loose" Carburetters.

Outlines of the Principles of the Most Widely-used Types.

A concise illustrated description of the operation of Carburetters at present on the market, which may be purchased "loose," *i.e.*, independently of the chassis to which they are to be fitted. In most cases the instruments described are produced by firms who specialise on carburetter design and manufacture. The descriptions and illustrations of the float chambers have in the majority of cases been omitted as confusing the issue, and having no direct bearing on the design.

No. 1.—The Achilles Carburetter.

This is practically two carburetters combined into one, although both are controlled by the same rotary throttle D. For slow running the small jet and choke tube L and K fixed on top of the float chamber are provided, the small jet tube L telescoping into the tubular needle valve O. The whole of this subsidiary starting and slow-running carburetter is easily detach-



Section of the Achilles carburetter.

D. Throttle.
E. Auxiliary air inlets.
F. Balls governing air inlets.
G. High-speed spraying nozzle.
H. Vaporising chamber.
I. Curved hot air inlet pipe.
J. Slow-speed gas conduit.
K. Slow-speed vaporising chamber.
L. Slow-speed spraying nozzle.
M. Float levers.
N. Float
O. Needle valve.
P. Needle seating.

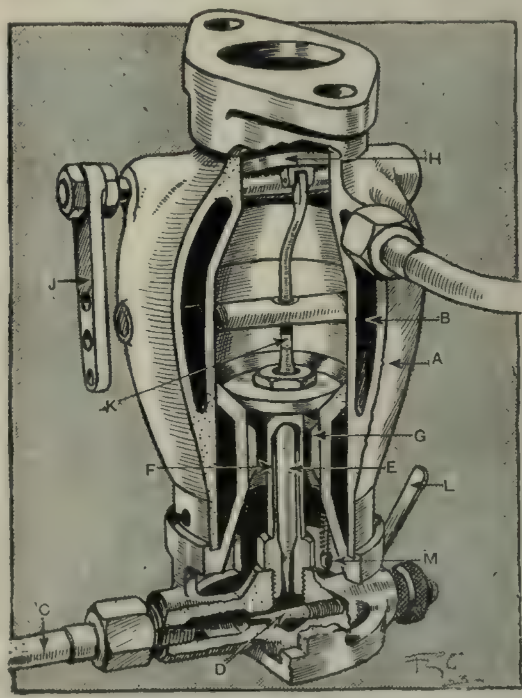
able with the aid of the thumb and fingers, and can, if desired, be removed while the engine is running. A hot water jacketing is provided around the throttle barrel, and the same jacketing space also warms the subsidiary inlet pipe. The unions for this water jacket do not appear in the section, but they are placed between the throttle barrel and the top of the secondary inlet pipe. The main jet G is the high speed spraying nozzle, and is of rather peculiar design; it is set diagonally in a long choke tube H, and consists of a thin tube communicating with a duct bored in the body of the carburetting chamber. It is fitted diagonally to enable rapid and easy removal without disturbing any other part. This diagonal tube is cross drilled, at the part which crosses the choke tube, with a number of fine holes which form the spraying nozzle. The petrol or other spirit is not taken from the base of the float chamber, but from a point about half an inch above it, so that the tendency is for dirt to sink to the bottom of the chamber and remain there instead of getting into the jet. An automatic auxiliary air inlet is provided at E; this is a ring full of holes which are covered by bronze balls of different size and weight according to the bore and stroke of the engine; these balls are lifted more or less according to the degree of suction provided by the engine and in accordance with the well-known G.A. patents.

Leo Ripault and Co., 64a, Poland St., London, W.

No. 2.—The Aris Floatless Carburetter.

In this carburetter, which has no float chamber, A is the exhaust-jacketed body of the carburetter, into the lower part of which is pressed the aluminium casting forming the choke tube G and carrying the feed needle valve D and the jet column F.

The petrol arrives by the union C, the delivery to the jet being adjusted by the needle valve D. Screwed



The Aris floatless carburetter.

A. Body of carburetter.
B. Exhaust jacket.
C. Petrol feed from tank.
D. Adjustable petrol supply valve.
E. Disc headed needle valve jet.
F. Jet column.
G. Venturi or choke tube.
H. Butterfly throttle valve.
J. Throttle lever.
K. Coupling between throttle and disc-headed valve.
L. Flooding lever.
M. Spindle and spring operated by lever L.

into the orifice above the needle valve is the jet column F, in which the disc-headed needle valve E (which is also the jet) is free to reciprocate. The valve spindle E is drilled down the centre, and has four inlets from the jet column just above the taper. H is a butterfly throttle operated by the lever J in the usual way. To

the upper end of the throttle is pivoted a bent chisel-headed rod K which serves two purposes. As the throttle is opened, and the upper end lifts, the chisel-headed stem lifts with it and permits the disc-headed needle valve E to rise from its seating in obedience to the suction of the engine. As the valve E rises the air passage is increased in area, as is the petrol feed by the simultaneous lifting of the needle valve E. The sharp tapered end of the chisel-headed stem has a second function in splitting and spraying the stream of petrol issuing from the top of the jet E.

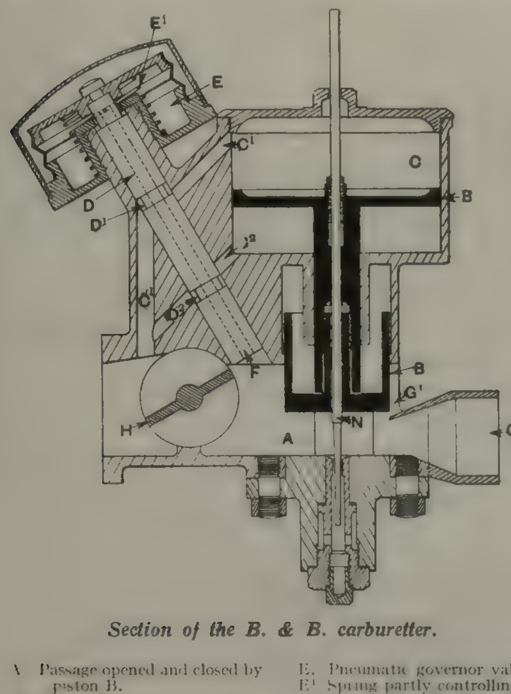
The lever L and the spring and spindle M are the means provided for flooding the carburetter when starting the engine. The depression of the lever L raises the spring encircled spindle and thereby lifts the disc-headed petrol valve E, so allowing the petrol to flow into the mixing chamber of the carburetter and provide a rich mixture.

The flow of petrol is entirely arrested through the main jet when the throttle is quite closed. An adjustable feed of gas for slow running is provided above the throttle valve.

Mr. A. A. Godin, 1, Red Lion Square, Holborn, London, E.C.

No. 3.—The Brown and Barlow Carburetter.

Reference to the sectional drawing will show that the B. and B. automatic carburetter consists primarily of a horizontal passage A, which is opened or closed by the sliding piston B. This has connected to it a



Section of the B. & B. carburetter.

A. Passage opened and closed by piston B.
B. Piston.
C. Cylinder.
C^1 C^2 Ports connecting A and C by governor valve E.
D. Balanced piston rod.
D^1 D^2 Annular grooves.
E. Pneumatic governor valve.
E^1 Spring partly controlling governor valve.
F. Hole through centre of rod D.
G. Hot air inlet.
G 1. Cold air inlet.
H. Throttle.
N. Tapered needle.

tapered needle N. The upper part of B is projected into C, which has two ports C_1 and C_2, these ports communicating through a governor valve into the passage A between the throttle and the engine. A balanced piston D, having cut in it two annular grooves D_1 and D_2, is placed in such a position that the grooves D_1 and D_2 can open or close the passages C_1 C_2 as it is raised or lowered. To the top of the piston D is attached a pneumatic governor E, which is maintained in its outward position by a spring E_1. Communicating with this governor and the passage A is a hole F (shown dotted), so that whatever pressure is registered in A the same pressure is transferred to the pneumatic governor E through F. When air is drawn through the carburetter by the engine suction, the pressure in the passage A tends to fall; this pressure is transferred to the governor E, and when a pre-determined pressure is arrived at, the spring E_1 is slightly compressed and the piston D is depressed a corresponding amount. This causes the groove D_1 partly to open the passage C_1, and the groove D_2 closes the port C_2, thus the pressure in C becomes unequal, and the piston B correspondingly rises until the pressure in A falls. Pressure also falls to the same extent in the pneumatic governor, and if it persists below a certain amount, then the spring E_1 tends to return the governor to its topmost position, and in so doing the groove D_1 closes the port C_1, and the annular port D_2 opens the port C_2 with a corresponding reversal of pressure in the chamber C, and consequently the piston B will descend and show increases of pressure in the chamber A. In practice it is found that the movement of B is very slow, as the governor E responds to the change of pressure with corresponding small movements of B. On the intake end a hot air inlet G is provided which leads only into the lower half of the port governed by B. The top portion G_1 opens direct into the air. This is for the purpose of automatically governing the temperature of the ingoing charge as the load varies. At light loads the piston B is close to the bottom of A, and the carburetter is taking all hot air. When G_1 starts to uncover, the temperature of the ingoing air gradually falls until when, in the full open position, the temperature of the hot and cold air combined should remain at about 60° F. The temperature at G should be about 100° to 130° F. The needle N is projected through the cap of the chamber C, and is friction tight in the piston B, therefore the needle can be raised or lowered from the outside of the carburetter while the engine is running if desired.

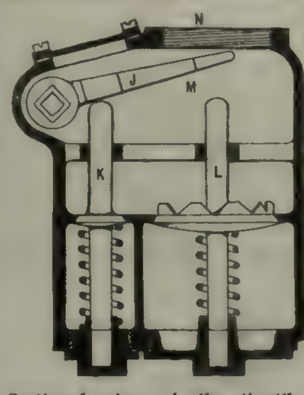
To provide for easy starting in cold weather a small by-pass (not shown on drawing) controlled by a knurled nut is provided. When starting this should be opened for about two minutes, after which it can be closed.

The throttle H consists of a tapered plug kept fairly on its seat by a spring. It is adapted to open the lower side first during the early part of the movement and afterwards the upper side, thus rendering the throttle a little less sensitive during the early portion of its movement. An ordinary type of float chamber is fitted which can be attached to either side of the spraying chamber.

Brown and Barlow, Ltd., Westwood Road, Witton, Birmingham.

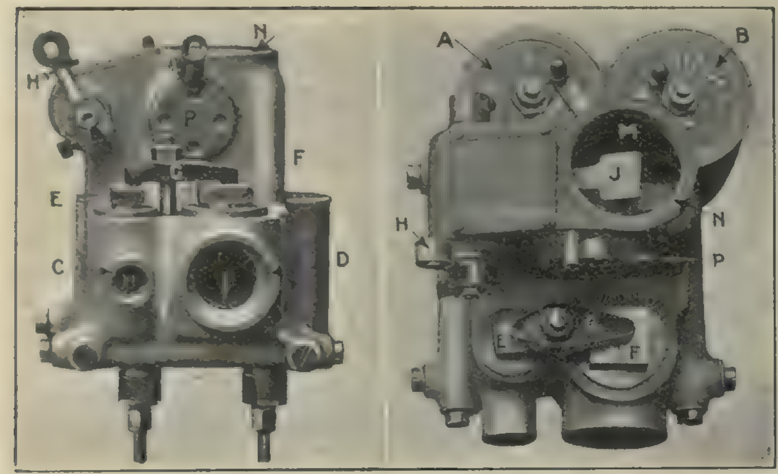
No. 4. — The Binks Petrol-paraffin Carburetter.

In this carburetter two float chambers A and B are provided. A is fed from the petrol tank and B from the paraffin



Sectional view of the throttle and mixing chambers of the Binks petrol-paraffin carburetter.

J. Throttle operating lever.
K. Petrol throttle valve
L. Paraffin throttle valve.
M. Mixing chamber.
N. Outlet to vaporiser and induction pipe.



Two views of the Binks petrol-paraffin carburetter.

A. Petrol float chamber.
B. Paraffin float chamber.
C. Air inlet to petrol jet.
D. Main air inlet past paraffin jet.
E. Choke tube surrounding petrol jet.
F. Main choke tube surrounding paraffin jet.
G. Dog piece securing choke tubes
H. Throttle control lever.
J. Throttle operating lever within mixing chamber.
M. Mixing chamber.
N. Outlet to vaporiser and induction pipe.
P. Hand-operated additional air valve.

tank. These two tanks could be combined, one division representing 20% for petrol, the remaining 80% of space being occupied by paraffin, which may be of quite a low grade.

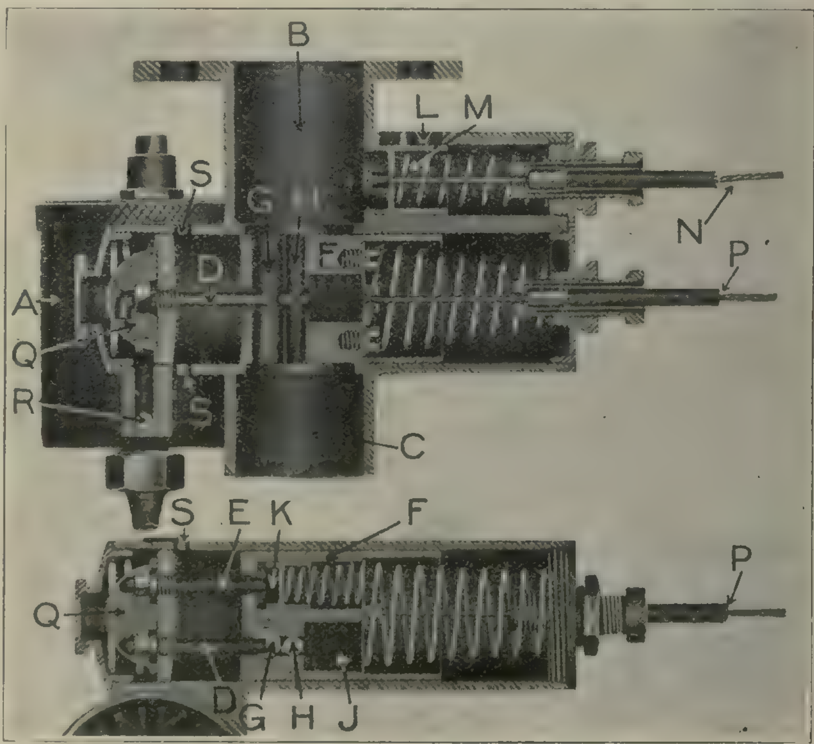
The petrol float chamber A is connected by the usual leads within the carburetter casting to a small jet, the end of which stands up within the air passage C, surrounded by a choke tube E. The paraffin, on the other hand, is conveyed from the float chamber B by a duct to the main jet within the main air passage D, with a similar but larger choke tube F. Both choke tubes are readily adjustable by slacking the nut which holds down the double dog G.

When it is desired to start an engine fitted with this carburetter, the throttle lever is opened a little way only, which has the effect of opening the small throttle valve K, fig. 1, without moving the main throttle valve L. Both these valves are of the inverted mushroom type, and are held up against their seatings by springs. The small valve K is that regulating the petrol gas supply, whilst L controls a supply of paraffin vapour. Therefore, when, as mentioned, the valve K alone is opened, the engine is supplied only with petrol vapour and air, which passes through the mixing chamber M and thence to the induction pipe by way of the outlet N. Attached to the latter outlet is an exhaust heated vaporiser which will be described later, and after the engine has been running a short while the vaporiser becomes heated, and the paraffin may be brought into use by the throttle being opened further. The end of the lever J will then bear upon the top of the valve L, so opening the latter and admitting to the engine paraffin vapour and air, which, meeting the petrol mixture in the mixture chamber M, passes with it through the vaporiser and thence to the engine. It will thus be seen that when the engine is pulling with the throttle more than halfway open both petrol and paraffin form the fuels, but the wider the throttle is opened the greater the proportion of paraffin to petrol, until with full throttle 80% paraffin is being used.

C. Binks, Ltd., Eccles, Manchester.

No. 5. —The New Binks Two-jet Carburetter.

The latest Binks carburetter for petrol consists primarily of two horizontal jets D and E, the former opening into vertical choke tubes G and H. When the engine is not running these tubes are closed and the jets sealed by spring loaded pads J and K. To start the engine tube H is opened slightly by partially withdrawing the piston throttle F, thus uncovering the jet D. To obtain more power jet D is further uncovered, and then the second choke tube G is opened, increasing the area of the choke tube, after which the throttle piston, moving further open, allows pad K to uncover the larger jet E until full power is



Elevation and plan of the Binks two-jet carburetter, showing the throttle piston slightly open so as to bring the small jet only into operation.

A. Float chamber.
B. Induction pipe.
C. Main air inlet.
D. Small jet.
E. Large jet.
F. Piston forming throttle valve.
G and H. Vertical holes in F forming the choke tubes for slow running.
J. Pad closing small jet when throttle is shut.
K. Pad closing large jet until throttle is partly open.
L. Air inlets for extra air and engine braking.
M. Piston covering extra air inlets.
N. Bowden wire operating extra air piston.
P. Bowden wire operating throttle and choke piston.
Q. Gauze strainer.
R. Petrol duct from float chamber to jets.
S. Inlets for air passing jets.

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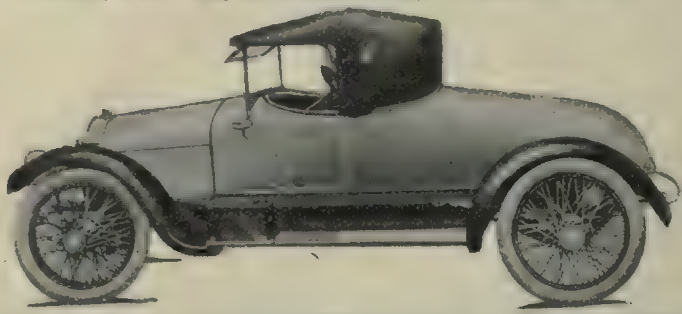

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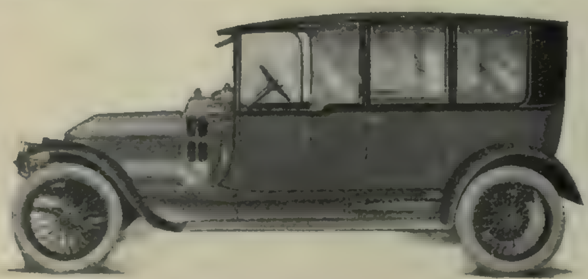

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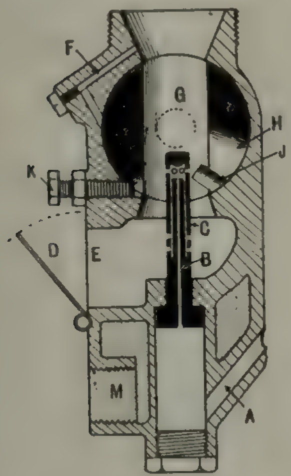
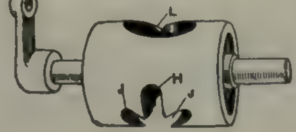
reached. To utilise the engine as a brake when running downhill the chokes and jets can be closed and the air port L opened by piston M. Both pistons are controlled by Bowden wires and cables. The main air inlet is at C, and the mixture outlet at B. The jets are easily accessible by unscrewing the cap of the strainer Q. A slight variation in the air supply for all choke positions is obtainable by means of a series of air holes drilled near the base of the jets and covered and uncovered by a rotatable spring slide. The float chamber has the float spindle to move upwards and to close the petrol supply by an inverted conical valve.

C. Binks, Ltd., Eccles, Manchester.

No. 6.—The Claudel-Hobson Carburetter (Touring Model).

A special feature of this carburetter is the peculiar formation of the throttle valve. The petrol enters at A and passes up the jet B, which, it will be seen, is of peculiar construction. Surrounding the jet proper is a sheath C, which is pierced by holes top and bottom, this arrangement producing an atomising effect upon the petrol issuing from the jet proper B. For starting up, the flap D is closed over the air inlet E, a very rich mixture passing through the passage F when the throttle G is closed. After the engine has been started the flap D is opened, and the mixture passes though the throttle block G, and on opening the throttle further the passage F is cut out by the throttle block as shown. By this time a small slot H surrounding the jet comes into operation, and as the throttle is opened and the volume of gas passing the throttle block increases, the slot H is opened out to form two wide cross slots, the form of which



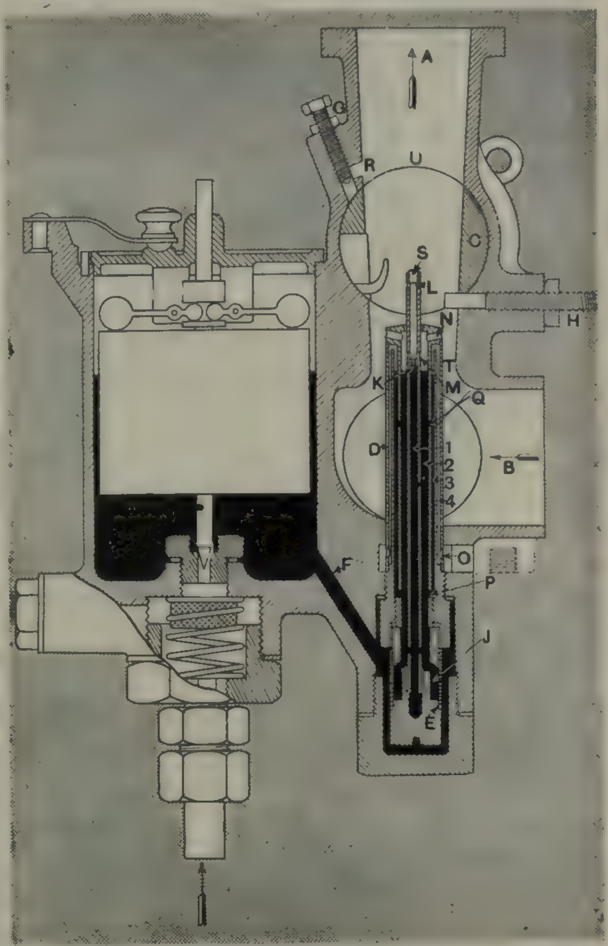


Two views of the Claudel-Hobson carburetter.

A. Petrol inlet.
B. Jet.
C. Sheath surrounding jet.
D. Flap valve over air inlet.
E. Air inlet.
F. Petrol vapour by-pass.
G. Throttle block.
H J. Low speed mixture slots in throttle block.
K. Lowest speed mixture adjusting screw.
L. Niche in throttle supplying sufficient mixture for dead slow free running.
M. Water jacket.

is shown at J. Further movement of the throttle brings the full throttle opening into operation as shown in the section. A fine adjustment of the slow speed mixture is given by the adjusting screw K. The size of the jet orifice is determined as usual, the shape of the apertures H and J being settled by the makers, and remain constant for each carburetter. A small niche L is cut into the throttle which allows sufficient mixture to pass when the engine is working dead slow or running light.

There is also the racing type Claudel carburetter, which, although not in general use, is fitted as standard to a few makes of cars, notably the D.F.P. We reproduce a section of the racing model carburetter, so that it can be compared with that of the standard pattern. One of the principal alterations is that the prolongation of the outlet A gives a very much truer venturi tube action than the ordinary pattern. Three annular feed columns are also arranged concentrically (all petrol in our diagram being shown solid black), the centre column being in communication with the starting jet S, air entering through the holes R, and so to the engine through a bypass in the throttle barrel. In racing carburetters it is desirable to maintain a constant head of petrol at the jet when the throttle is closed, so that if sudden acceleration be required there is sufficient petrol to meet it. In the starting position air is drawn through N, whence it descends to M, and, entering these holes, it mixes with the spirit drawn from jet K; the mixture then rises and issues as a spray from L. Acceleration then

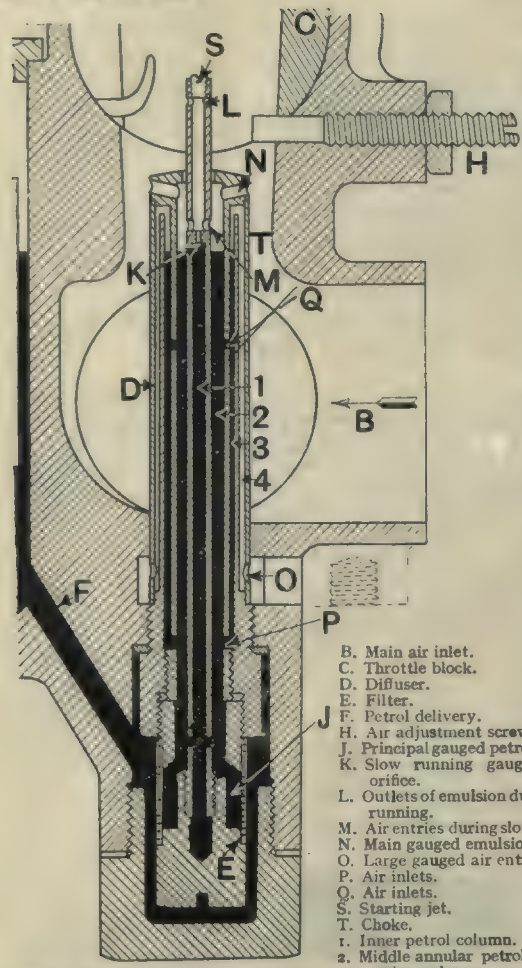


Section of the Claudel-Hobson racing carburetter.

A. Outlet to engine.
B. Main air inlet.
C. Throttle block.
D. Diffuser.
E. Filter.
F. Petrol delivery.
G. Slow running adjustment screw.
H. Air adjustment screw.
J. Principal gauged petrol orifices.
K. Slow running gauged petrol orifice.
L. Outlets of emulsion during slow running.
M. Air entries during slow running.
N. Main gauged emulsion outlets.
O. Large gauged air entries.
P. Air inlets.
Q. Air inlets.
R. By-pass.
S. Starting jet.
T. Choke.
U. Mixing space.
1. Inner petrol column.
2. Middle annular petrol or emulsion column.
3. Outer annular petrol or air column.
4. Annular air passage to diffuser.

(See also enlarged section on next page.)

produces the following effect: suction ceases at S owing to this being closed by the throttle barrel and the choke tube being withdrawn from it by the same action. The air rushing up T now produces sufficient suction on holes N, at the head of diffuser D, to draw in air at holes O up the annular space 4 down to the level of the petrol in 3, whence it passes mingled



B. Main air inlet.
C. Throttle block.
D. Diffuser.
E. Filter.
F. Petrol delivery.
H. Air adjustment screw.
J. Principal gauged petrol orifices.
K. Slow running gauged petrol orifice.
L. Outlets of emulsion during slow running.
M. Air entries during slow running
N. Main gauged emulsion outlets.
O. Large gauged air entries.
P. Air inlets.
Q. Air inlets.
S. Starting jet.
T. Choke.
1. Inner petrol column.
2. Middle annular petrol or emulsion column.
3. Outer annular petrol or air column.
4. Annular air passage to diffuser.

Enlarged section of the Claudel-Hobson vaporising chamber.

with petrol through holes Q and up 2, passing out at N, from which it issues in the form of fine spray. Continued opening of the throttle, accompanied by increased suction, causes the petrol in the annular columns to fall gradually; in fact, the volume of air entering at O is so great that some of it goes back to the engine through Q, until finally the petrol level falls to P, and sufficient air enters at P to carry away up the annular space 2 to holes N all the petrol that can enter through J. It is claimed that this carburetter is insensitive to barometic differences, as the petrol levels are dependent on the air volumes entering at O, P, and Q, which in turn are dependent on the demands of the engine.

H. M. Hobson, Ltd., 16, Pall Mall, London, S.W.

No. 7.—The Convac Carburetter.

The object of the Convac carburetter is to equalise the mixture by making the negative pressure act as its own governor by causing any increase of negative pressure in the mixing chamber and air passages to be communicated to the space above the spirit in the float chamber, so putting, as it were, a braking effect on the flow of spirit from float chamber to jet chamber. Referring to the accompanying diagrams, the mixture having been correctly set for slow running by the proportioning of the jet bore and the choke tube A, any movement of the throttle or variation of engine speed tending to increase the negative pressure in the mixing chamber B is communicated to the float chamber C by way of the passage D, the tube E, and the pipe F. The latter leads to the interior of the float chamber, through the duct G, which is provided with an adjusting screw H. The float chamber is rendered practically airtight.

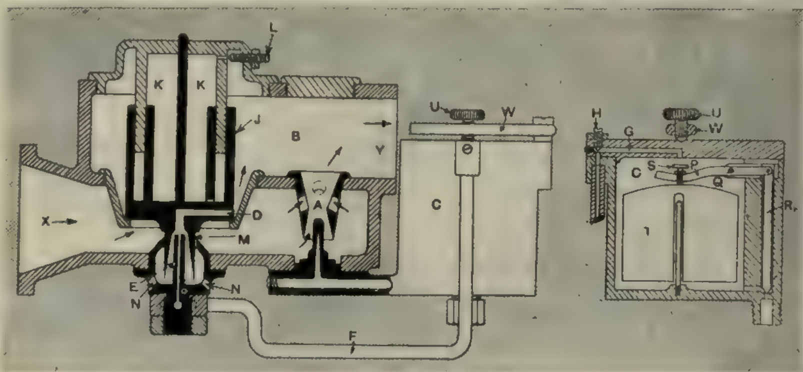
A passage D is formed in an automatic additional air piston J, which is subjected to a pronounced dashpot effect by the chamber K. When the air piston is raised by the engine suction the negative pressure in the mixing chamber is still communicated to the float chamber, but to a disproportionate extent owing to the shape of the thimble extension M. That is to say, as the air piston is lifted the suction communicated through the passage D draws a great deal of air through the holes N instead of being almost wholly employed in exhausting the float chamber.

The sectional view of the float chamber shows that this varies somewhat from the usual design of this part, owing to the necessity for the total enclosing of the needle valve and levers. The lever P is pivoted at Q, and carries the needle valve R. An adjusting screw is provided at S to vary the cut-off of the petrol when necessary. The float T is guided by the central pin screwed into the bottom of the chamber. The screw seen at U secures the lid of the float chamber and passes through the swivelling bridge piece partly shown at W.

The Constant Vacuum Carburetter Co., Market Street, Paddington, London, W.

No. 8.—The Cox Streamline Carburetter.

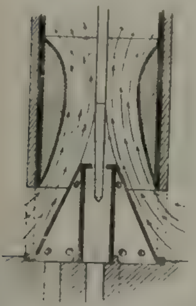
From the sectional drawings it will be seen that the Cox carburetter consists of an L pipe with a jet in it. The jet takes the form of a ¼in. tube with a cap having an orifice of about ⅛in. Into this orifice a taper needle is inserted and withdrawn as the throttle is closed or opened. At its closed position there is still a small annular space between the needle and the side of the jet orifice, and, of course, as the needle is raised the area of the orifice and, consequently,



Two part sectional views of the Convac carburetter.

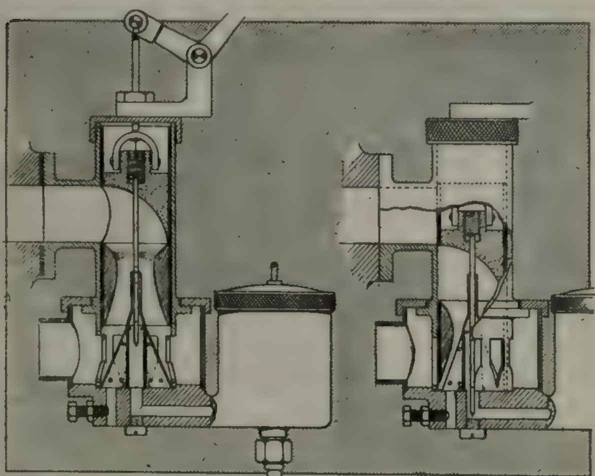
A. Choke tube.
B. Mixing chamber.
C. Float chamber.
D. Vacuum passage in air piston.
E. Vacuum tube.
F. Vacuum pipe communicating with float chamber.
G. Vacuum duct in lid of float chamber.
H. Vacuum adjusting screw.
J. Additional air piston.
K. Dashpot.
M. Thimble extension of air piston.
N. Air holes.
P. Float toggle lever.
Q. Pivot.
R. Needle valve.
S. Adjusting screw.
T. Float.
U. Holding-down screw of float chamber.
W. Bridge-piece.
X. Air inlet.
Y. Mixture outlet to throttle valve and engine.

the supply of petrol is correspondingly increased. Round this jet is a series of air ports having taper bottoms which are not sharp V tapers, but slightly curved, and these parts are opened or closed as the needle is moved up or down in consonance with the opening or closing of the throttle. The throttle consists of a tube with a curved passage in it, this passage registering with the inlet pipe. The tubular throttle, further, carries the needle for the jet, and as it is raised or lowered, it also opens or closes the air ports. When the throttle is fully open the needle is raised high in the jet and the air ports are also wide open. To get easy starting and slow pulling, the throttle is practically closed and the air ports are closed all but a fraction, only just the fine point of the V being open, and the needle is well into the jet orifice, so that the annular space between it and the jet orifice is very small indeed. Around the jet tube is a petticoat, or cone, in which some small holes are bored, and there are holes beneath it through which air is drawn, in addition to that passing through the tiny apertures at the bottom of the V slots. The larger of these under holes can be adjusted by means of a bolt and nut, so that the adjustment can be set for slow running.



View showing jet-end of taper needle and choke tube raised to the position it assumes with the throttle almost fully open. The arrows denote the direction of the ingoing air.

The throttle is formed in one piece with the choke tube, and consequently the latter moves up and down with it. In the slow running position, therefore, the most restricted diameter of the bore of the choke is at the same level as the top of the jet, so that the negative pressure is maintained despite the throttle closing and the resultant loss in engine speed. At the other extreme, *i.e.*, full throttle, the choke is raised high and the top of the jet is in the largest diameter of the choke tube, as shown in the left-hand view.



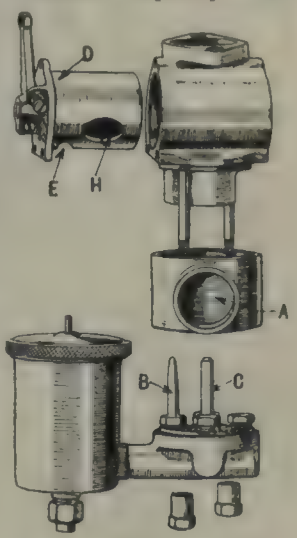
Two part sectional views of the Cox carburetter. On the left the throttle is shown fully open, choke tube and taper jet needle both raised high. The other view shows the positions of the details when the throttle is shut for slow running. The outside surface of the choke tube forms a sliding shutter for the air inlet holes. The jet is shown solid black, a bridge piece with an extension being formed above it to act as a guide for the taper needle.

It will be realised that at all times the petrol issuing from the jet is of annular form—that is to say, it takes the form of a very thin-walled cylinder, or pipe, of petrol.

The Electric Ignition Co., Ltd., Sampson Road North, Birmingham.

No. 9.—The Garner Carburetter.

The Garner carburetter is of the two-jet variety, and is characterised by its extreme simplicity. Air enters at a port A below the jets B and C, and passes through choke tubes, the size of which may be set to suit different engines. The gas is then controlled by a barrel throttle D, which determines the amount of mixture to pass into the cylinder. Circular ports E and H are cut in the barrel to correspond with the choke tubes, and are so aranged that first the small jet B only is in operation. Then, as the main and larger jet C and air supply are opened up the small jet is shut off. The Garner carburetter is light and small, and is adaptable to almost any engine.



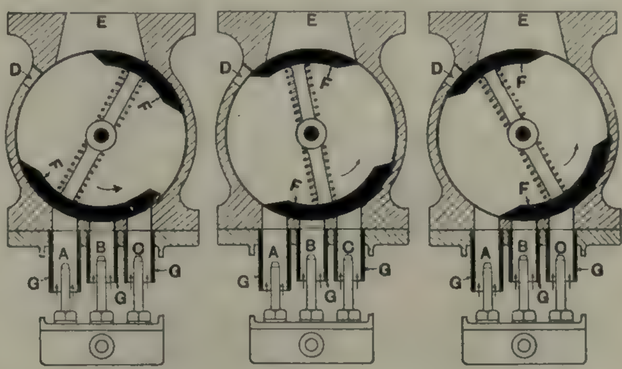
The Garner two-jet carburetter. The letters are referred to in the accompanying text.

Henry Garner, Ltd., Moseley Motor Works, Birmingham.

No. 10.—The H.P. Carburetter.

This carburetter has three jets, all three in line with the passage to the induction pipe and each surrounded by an air intake tube G, a spring loaded throttle block F being inserted in the induction pipe above the jets. The action is extremely simple, and is as follows:

Fig. *a* shows the throttle block in such a position that all three jets, A, B, and C, are shut off and the pure air port D open so that pure air may pass directly to the engine.



The H.P. carburetter shown in vertical section in the first three of its main positions. The letters are referred to in the text.

Fig. *b* shows the throttle block in such a position that all three jets are still shut off and pure air prevented from passing into the induction pipe. Fig. *c* shows the first jet A in operation by the rotation of the throttle block F to the position shown, and in fig *d* jet B is also opened, while fig. *e* shows all three jets

Loose Carburetters.

fully opened and the throttle opening to the induction pipe fully open also. A still further movement of the throttle block to the position shown in fig. *f*

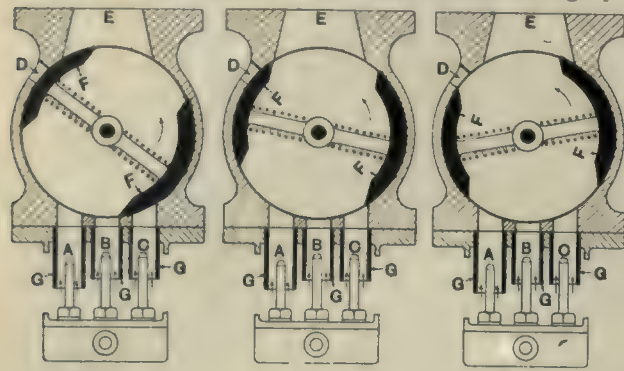


Fig. d. *Fig. e.* *Fig. f.*

The H.P. carburetter shown in vertical section in the last three of its main positions.

allows extra air to be admitted through the pure air port D.

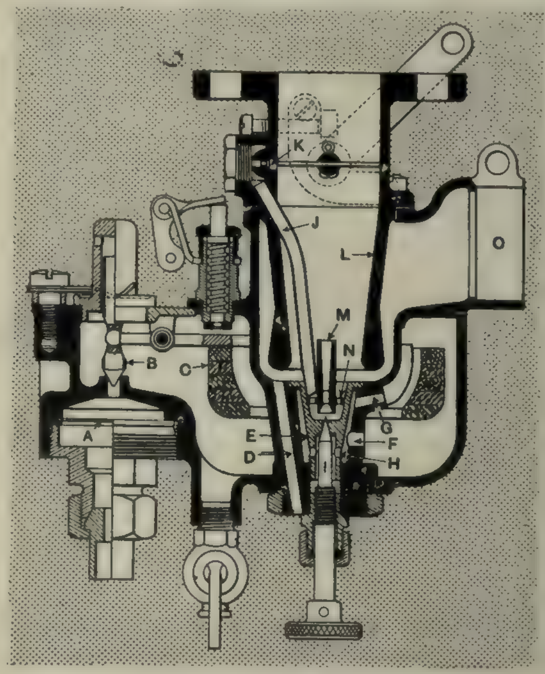
Henry Garner, Ltd., Moseley Motor Works, Birmingham.

No. 11.—The Holley Carburetter.

The jet E is formed in a cup-shaped chamber. When the engine is stationary the petrol level rises part of the way up this cup-shaped chamber to the foot of the starting tube J. It is, therefore, obvious that, if the butterfly throttle be opened a mere fraction, the engine, on being turned over, will suck a very rich mixture up J through K and will start. K, it should be mentioned, is made as a screw plug, and plugs of different sized orifice are supplied, so that just the right quantity of petrol for starting the engine and running it dead slow can be provided by using the right sized plug. As soon as the engine has started and the throttle is opened more widely the petrol level in the cup drops, and the jet functions in the usual way. It will be seen that the orifice F connects the float chamber with the jet and it will not pass more than a given amount of petrol, so that when the demands of the engine for petrol become greater the level is automatically lowered, and the cup above the jet is no longer filled with petrol.

F, as shown in the drawing, has no method of adjustment, and none is required when the carburetters are turned out for a given size of engine, but when it is desired to move a carburetter from engine to engine, or to make the same carburetter suit different sizes of engines, F can be provided with an adjustable plug like K, so that just the right size of orifice can be secured. This also provides means of adjustment should any great change in the viscosity of the fuel regularly used be made.

The jet itself can be adjusted by the needle valve I, so that just the correct aperture can be given, and, once given, the adjustment locked, but there is also another uncommon feature in the admission of air into the jet itself. It will be noticed that there is a channel G at the side of the jet chamber. This is an air passage between jet E, through H, and the float chamber into which air is admitted freely by small "breather" orifices, and the theory is that a small quantity of air passes through G and intermingles with the petrol coming through F to the jet. Above the jet there is a mixer tube or funnel M, to assist in the atomisation of the petrol from the jet, which passes up it, some air being taken at N. The main principle of the carburetter is that the petrol orifice F from the float chamber to the jet is never subjected to suction but only to gravity, and can never pass more than a predetermined quantity of petrol



A sectional view of the Holley carburetter.

A. Filter gauze.
B. Petrol inlet valve.
C. Cork float.
D. Petrol overflow in case of flooding.
E. Jet piece in cup-shaped chamber.
F. Petrol inlet to jet chamber from float chamber.
G. Air inlet to jet chamber.
H. Connection between jet and jet proper.
I. Needle valve to jetfor regulating.
J. Starting tube.
K. Starting nozzle.
L. Choke tube.
M. Mixer tube above jet.
N. Holes in base of M.
O. Main air inlet.

in a given time. This is brought about by the air orifice G, as without this there would be a direct suction not only on the jet but on F.

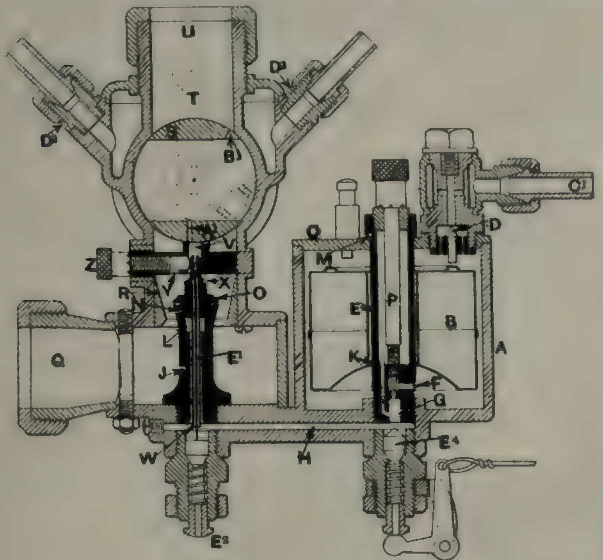
Holley Bros., Ltd., 46, Northumberland Road, Coventry.

No. 12.—The Longuemare-Hardy Carburetter.

When the throttle S is closed the quantity of fuel required to keep the engine slowly turning over is very small—less than that which flows into G and H. The surplus therefore rises in the column E through the hole K to the normal level in the float chamber. With the throttle shut, or, rather, in the slow running position, the petrol is drawn up the tube W to the jet X, the head of which is enveloped in a small choke tube V, air being drawn in through Y, the mixture passing to the engine through the pilot holes A1 and B1 in the throttle block.

Sudden opening of the throttle S cuts off the slow running jet X and its choke V, owing to the peculiar form of the throttle S, air being now drawn through the main choke R from the air inlets Q, and petrol from the rose jet N, below which is a reserve of petrol easily drawn by the engine from the chamber L, which again is rapidly replenished by the column of petrol in the pillar E through the passages K and H. However, the demands of the engine have now reached a pitch with which the orifice G cannot cope, consequently there is no surplus to pass up K to form a reserve column. In fact, the converse happens; the demand in the passage H is so great that, besides drawing petrol from G, air is also drawn from M, down

E and through K, and, together with the petrol, emerges at the sprayer N, where it impinges on the plate O, from which it rebounds horizontally, and is met by the upward draught of air through the choke R, and carried through the throttle block to the induction pipe U to the engine. Further movement of the throttle again uncovers the jet X, and so an unrestricted flow is provided for the air from the inlets Q to the induction pipe U, except for the bridge carrying the pilot choke V. The latest models are provided with two useful devices; one is a pilot jet cleaner E1: this is a needle normally held out of engagement by a coil spring; if the jet be dirty the push button E2 is pressed and the needle passes through the jet hole and removes any obstruction. The second addition is a pure air scavenging device which allows the petrol to be cut off by the stop plug



Section of the model F.B. Longuemare-Hardy carburetter.

- A. Float chamber.
- A¹ B¹ Holes in throttle for mixture for slow running.
- B. Float.
- C. Float chamber cover.
- C¹ Petrol supply pipe.
- D. Constant level float valve.
- D¹ Hot jacket connections.
- E. Compensating column.
- E¹ Jet cleaning needle.
- E³ Push button.
- E⁴ Stop plug.
- F. Petrol orifices.
- G. Petrol orifice.
- H. Petrol channel.
- J. Jet column.
- K. Air or petrol holes.
- L. Petrol chamber.
- M. Air holes.
- N. Main mixture exits.
- O. Deflector.
- P. Petrol supply adjusting valve.
- Q. Main air inlet.
- R. Choke tube.
- S. Throttle.
- T. Throttle lever (dotted).
- U. Outlet to engine.
- V. Slow running choke.
- W. Slow running petrol supply tube.
- X. Slow running jet.
- Y. Slow running air inlets.
- Z. Slow running adjustment screw.

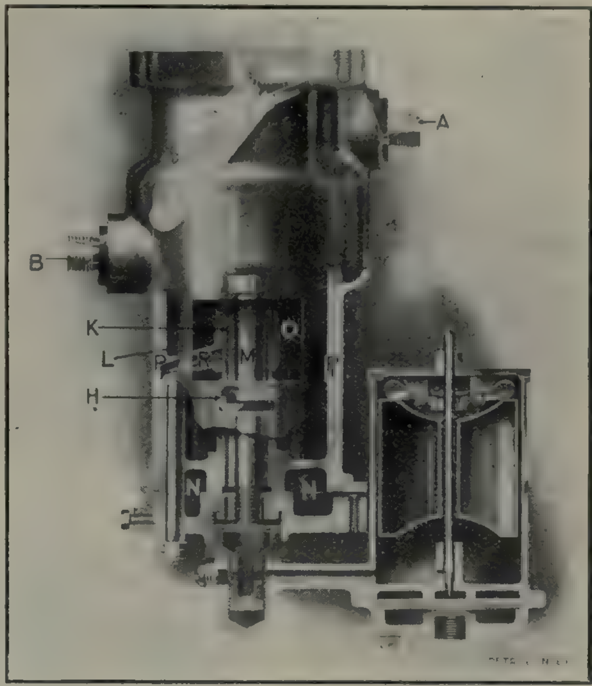
E4, operated by Bowden wire or other control.

E. J. Hardy and Co., Ltd., Queen Victoria Road, Coventry.

No. 13.—The Polyrhoe Carburetter.

In the Polyrhoë carburetter (new type) the row of jets K is arranged vertically, and in consequence the piston L controlling the jets operates vertically, the weight of the piston providing the required force to counteract the suction of the engine. The jets K are formed by slots cut in a series of thin brass washers and are spirally and alternately arranged around the central column M. The jets K are progressively uncovered by the piston L lifted by the suction of the engine, so that as the throttle is gradually opened a greater number of jets is brought into operation. As the piston rises it uncovers an aperture O in the wall of the carburetting chamber, through which passes the air to mix with the petrol vapour. The movement of the piston is controlled by the dashpot N.

To correct the mixture and make it suitable to various atmospheric conditions the aperture O can be



Sectional view of the Polyrhoe automatic carburetter.

- A B. Hot water jacket connections.
- G. Stop pin for adjusting range of piston movement.
- H. Air hole for slow running.
- K. Jets.
- L. Piston.
- M. Central column.
- N. Dashpot.
- O. Adjustable main air inlet on piston L.
- P. Groove round piston L.
- R. Diagonal conduit communicating with P.

varied in size by rotating piston L, and causing the ports in the piston and wall of carburetter to overlap. In this way the degree of suction can be varied proportionately over the whole range of the carburetter. The object of the groove P P round the outside of the piston is to relieve any negative pressure on the inoperative jets inside the cap, and is arranged so that into whatever position the piston is rotated it always communicates with the outside air *via* the diagonal conduit R. The adjustable air hole H supplies air for slow running, the piston is then right down and main air port is shut off. The float chamber can be swivelled to any position, and the throttle is of the butterfly type. To warm the carburetting chamber it is surrounded by a water jacket which can be connected to the engine water-cooling system at A and B.

Polyrhoë Carburetters, Ltd., 144, Great Portland Street, W.

No. 14.—The Smith Four-jet Carburetter.

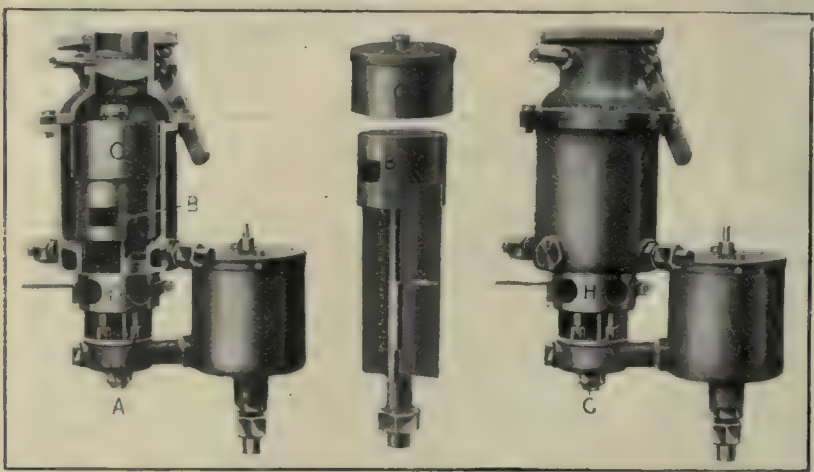
In the Smith carburetter the float chamber is of the usual type, and has cast upon its lower side a table arm forming the petrol lead and carrying the four jets. The jets each enter a vertical passage formed by the cruciform section of the controlling valve guide B, which forms the central portion of the carburetter. The upper portion of B is made cylindrical, and is provided with four rectangular ports cut at different heights in its periphery, a port to each vertical passage. This cylindrical portion of the valve guide B carries a cap or piston valve C which is free to rise or fall, the former by engine suction, the latter by gravity. If the engine is not running, the piston valve C takes

Loose Carburetters.

its lowest position, and in this position the rectangular ports in B are closed with the exception of the lowest, which remains half open.

Then the carburetter is in the starting position, and it will be seen that as the throttle is opened and the engine suction is increased the controlling valve rises higher and higher, opening the ports successively until all four are fully open and the engine is getting its maximum amount of fuel. It is generally found that a somewhat rich mixture facilitates starting, slow running, and acceleration, so the first jet to come into operation is comparatively large, and the jets become slightly smaller for each succeeding choke tube. The jets are calibrated, and numbered with the number of cubic centimetres of petrol which they will pass in one minute with a suction equal to 6in. head of petrol, this being the degree of suction automatically maintained on each jet whatever the speed of the engine. The jet table can be at once withdrawn by unscrewing the nut beneath it. By means of a rotary sleeve valve D, which can be actuated from a lever set on the dashboard or steering wheel, the driver can alter the mixture while running.

The throttle valve in the case of four-cylinder engines takes the form of a vertical cylinder pierced with eight ports diametrically opposed to each other. With engines of six cylinders the butterfly type as shown is supplied.



The Smith four-jet carburetter.

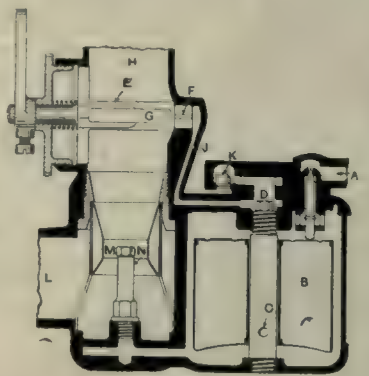
The view on the left shows the Smith carburetter in part section: A the jets, B the central valve guide, C the controlling piston valve, D the air supply regulator. In the centre is the controlling valve guide showing the cruciform lower half: B is the guide and C the piston valve. On the right is a view of a complete carburetter.

S. Smith and Son, Ltd., 179-185, Great Portland Street, London, W.

No. 15.—The Solex Carburetter.

Petrol enters this carburetter at A and flows through a peculiar type of needle valve into the float chamber B, whence it flows through the orifice C into the standard of the jet D. When starting up, the throttle E is closed with the exception of a small passage F communicating between a slot G in the throttle spindle, which in turn communicates with the induction pipe H, and the passage J. On starting up, the suction draws petrol through the small jet D, passages J and F, into the slot G, and so into the induction pipe H, the ball valve K being lifted sufficiently to give a mixture suitable for starting purposes. As the throttle E is opened, however, the increased amount of air necessary is drawn in through the air intake L through the choke tube M and past the jet N, the gases travelling past the throttle E into the induction pipe H.

S. Wolf and Co., 115, Southwark St., London, S.E.



A vertical section of the Solex carburetter.

- A. Petrol inlet.
- B Float chamber.
- C. Petrol passage.
- D. Small jet.
- E. Butterfly throttle
- F. Passage in throttle spindle.
- G. Slot in throttle affording communication between passage J and induction pipe H through passage F.
- H. Induction pipe.
- J. Rich mixture passage.
- K. Ball air valve.
- L. Main air intake.
- M. Choke tube.
- N. Main jet.

No. 16.—Sthenos Carburetter.

The float chamber A is of the usual type. From it petrol flows by the channel B into the well C. Its entry to the well C is *via* the plug D, which has a very small orifice, so small, in fact, that more petrol cannot enter the well C than can be taken by the engine pilot jet E, which also takes the form of a screw plug. In the well C is an air hole F, so that it will be seen that the well is open to the atmosphere. Down this well a small tube G, connected to the pilot jet E, runs, and the air for the pilot jet is taken up the aperture H, and (when the throttle is as shown in the diagram) has no effect upon the main jet J, which is fed by petrol through the same channel B as the small jet, but the petrol passes through a helical passage in the plug K, which the maker terms a resistance, and the mission of this will be explained later. With the throttle L in the position shown, the main jet J is closed to the engine, but the pilot jet E is open to it. Now the throttle can be adjusted by a stop so that the engine will just run on the jet E and the air which comes up H, and which, it will be observed, places no suction on the main jet J, as the volume of air is so small and the main air intake M so large by comparison with the air channel H, which supplies all the air required for the small jet. As soon as the throttle is opened the suction on the main jet J commences, and the petrol drawn through it causes the level of the petrol in the pilot well to fall. The further the throttle is opened, the more completely is the pilot jet E put out of business, as not only is practically all suction removed from it, but it has no petrol to serve, as the level in the well C falls below the bottom of the pilot jet tube G. To prevent an undue flow of petrol out of the main jet at high engine speeds when the suction is at its strongest, it will be seen that the helical plug K is inserted in the petrol channel B. While this has no effect at low fluid speeds, it acts as a brake or resistance at high fluid speeds, and, consequently, an undue proportion of petrol to air is not supplied to the main jet at high speeds; indeed, at the highest

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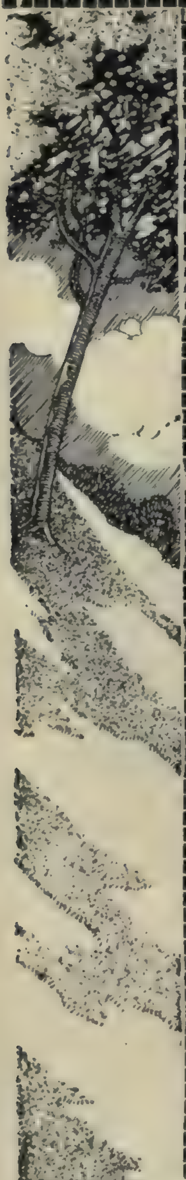

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The All-British Standard Light Car is specially adapted for Colonial use, and has already achieved conspicuous success in the Colonies and abroad. The chief points in its construction which have gained for it its great popularity may be briefly summarised as follows:

A four-cylinder engine (R.A.C. Rating 9·5 h.p.) of unusual silence and smoothness. A single-plate clutch with very light driving plate, giving very sweet engagement and making gear changing extremely easy. A three-speed gear box with gate change. A very substantial back axle with overhead worm. H section front axle of stamped steel. Pressed steel frame. Long and easy springs and carefully designed coachwork.

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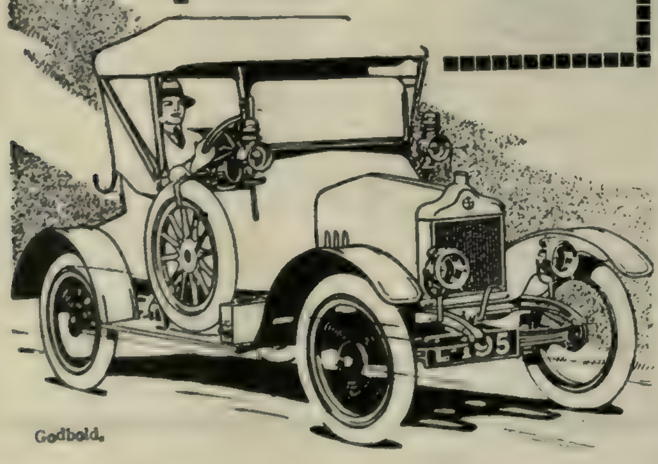
The Standard Motor Co., Ltd., Coventry, — England.



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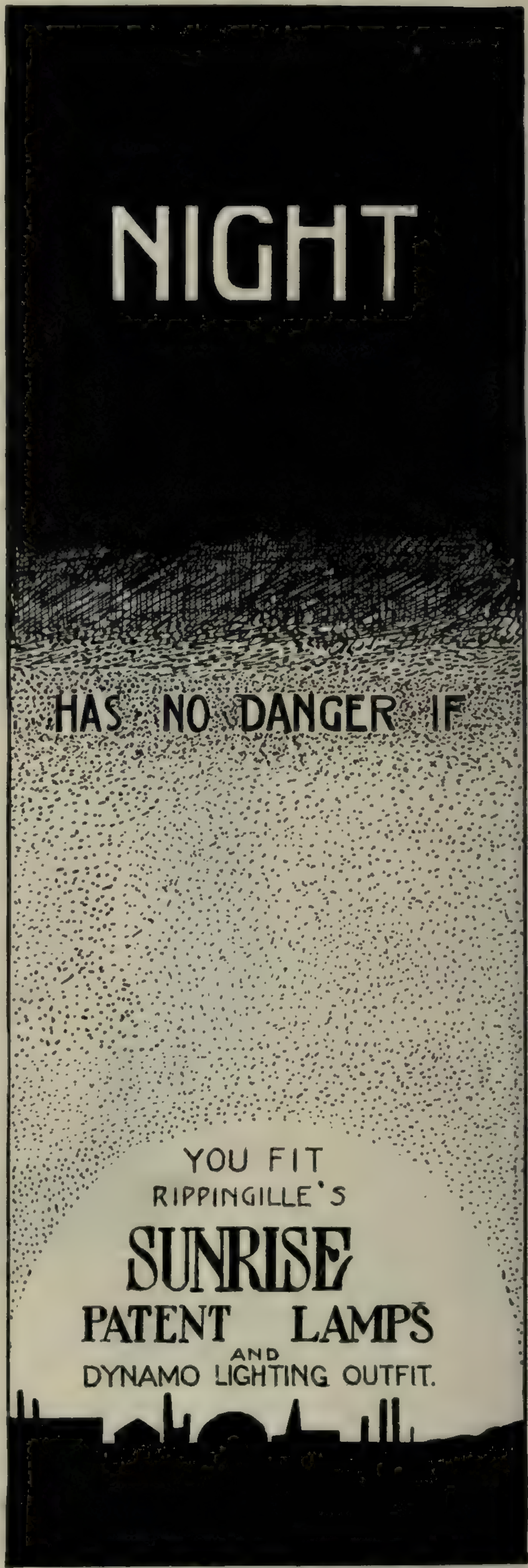
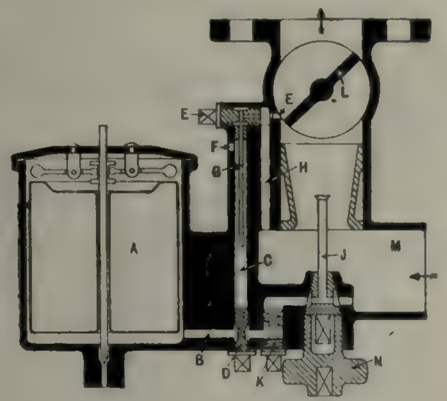


RIPPINGILE'S ALBION LAMP CO., LTD.
ASTON ROAD, BIRMINGHAM.

speeds the level of petrol descends to practically that of the top of the plug D.

One of the good points of this carburetter scarcely realised from the drawing is that the nut N beneath the jet not only serves as a lock-nut to hold the jet in position, but, when it is unscrewed, the square hole



The Sthenos carburetter.

A. Float and float chamber.
B. Petrol channel to both jets.
C. Petrol well for pilot jet.
D. Entry plug to pilot well C.
E. Pilot jet orifice.
F. Air hole to pilot well.
G. Petrol tube to pilot jet.
H. Air channel for pilot jet.
J. Main jet.
K. Helical resistance to check flow to main jet at high fluid speeds.
L. Throttle.
M. Main air orifice.
N. Lock-nut to main jet, also serving as box key to all parts of carburetter.

in it serves as a box key or spanner by which the jet can be instantly removed, and, further, it will unscrew the top jet plug E, the regulating orifice D, and the resistance K. Not only so, but each screw plug is of a different size, so that the wrong one cannot be inserted in position. The float chamber can be opened by a mere twist of the lid. We have, therefore, an extraordinarily accessible carburetter complete in itself, which can be dismantled without any outside tools.

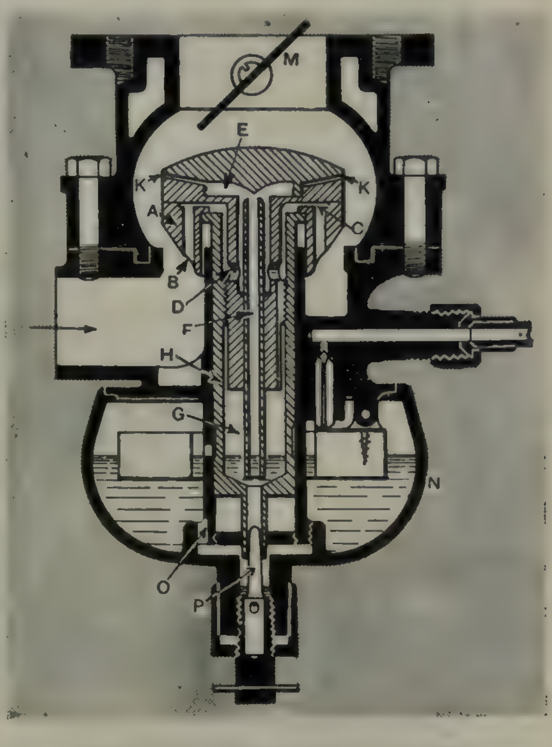
J. A. Ryley, 73, Weaman Street, Birmingham.

No. 17.—The Stewart-Precision Carburetter.

This carburetter was used on the record-breaking Talbot car at Brooklands. The float chamber N contains a concentric hinged cork float, which takes effect upon the needle valve controlling the entry of petrol from the feed pipe on the right. From the float chamber the petrol finds its way through the hole O and past the taper adjusting valve P to the well G. Into the latter dips the aspiration tube F, the petrol level being such that when the engine is at rest the lower end of this tube dips into the petrol in the well G. When the engine is started the suction draws petrol up the tube F and out at the top through the passages K, mingling *en route* with air which is drawn through the several passages B, C, and D, formed in the body of the extra air valve A, which is shown raised somewhat from its normal position. The mixture of the in-going air and the petrol first occurs in the small mixing chamber E, the mixture passing to the engine by the passages K and the throttle M. When the throttle is partly opened the increased suction raises the air valve to the position shown, and extra air is drawn directly past it, mingling with the rich mixture issuing from the passages K. The raising of the extra air valve also has effect upon the petrol feed, for the lower end of the air valve has an extension which, as shown, falls over the taper valve P, so that when this extension is lifted higher the shape of the taper valve allows more petrol to pass, and as this corresponds to the limiting orifices of the usual type of carburetter, it may be said that the raising of the air valve enlarges the jet. Further opening of the throttle lifts the valve still more, so admitting more air and allowing a greater quantity of petrol to pass in unit of time.

It has been mentioned previously that when the engine is not running, the lower end of the aspirating tube F is below the petrol level in the well G. The advantage of this is appreciated at starting, for there is thus an additional supply of fuel which is directly drawn upon at very low engine speeds. When the engine is running normally this additional supply is quickly used up, and the normal amount of petrol passes the valve P from the float chamber.

Owing to the piston-like formation of the air valve at H, which works in a cylinder formed in the body of the carburetter, there is a very appreciable dash pot effect which prevents violent reciprocating movements of the air valve, and ensures a steady variation of air opening as the suction of the engine directs.



Section of the Stewart-Precision carburetter.

A. Extra air valve.
B C D. Air passages in air valve.
E. Primary mixing chamber.
F. Aspiration tube.
G. Petrol well.
H. Piston extension of air valve.
K. Exit passage for rich mixture.
M. Butterfly throttle.
N. Float chamber.
O. Petrol outlet from float chamber.
P. Taper adjustable petrol valve.

All the parts in the sketch which are sectioned by cross-hatching (containing details lettered A to K inclusive) move with and form part of the combined air and petrol valve.

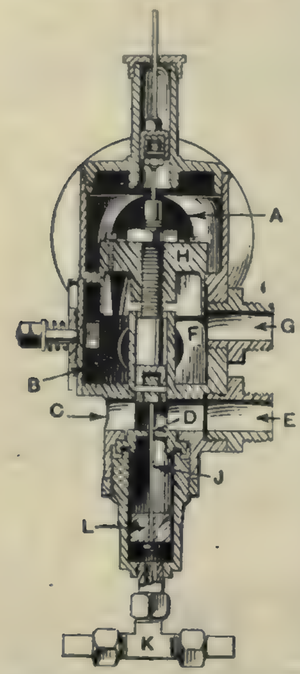
The Stewart-Precision carburetter is supplied in this country by the Stewart-Precision Carburetter Co., Ltd., 199, Piccadilly, London, W.

No. 18.—The Stewart-Morris Paraffin Carburetter.

When the induction pipe throttle A is nearly shut (*i.e.*, for slow, light running), the auxiliary air throttle B, which is connected with it by a link, is completely

Loose Carburetters.

shut, and all air passing to the engine is drawn in at C, whence, passing over the fuel orifice D, it passes on through E to the vaporiser. The carburetted air from the vaporiser then re-enters the carburetter, passing into the mixing chamber F. at G, and, by lifting the valve H, passes through the throttle to the engine. An adjustable tapered needle J working in the fuel orifice D is attached to the valve H, the vertical movement of which, therefore, controls the amount of fuel which is allowed to mix with the air passing in from C. When the throttle is further opened, the auxiliary air throttle B is also opened, and still further air can be allowed to enter the mixing chamber F by a hand-controlled valve not shown in the sectional illustration. No float chamber is used, the fuel (either paraffin or petrol) entering at K.

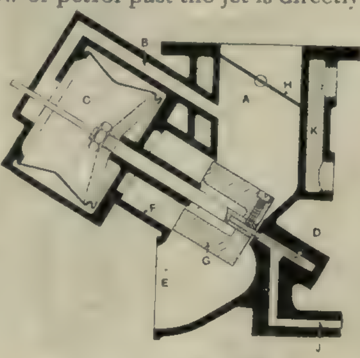


Sectional view of the Stewart-Morris paraffin carburetter. The letters are referred to in the text.

The Stewart-Precision Carburetter Co., Ltd., 199, Piccadilly, London, W.

No. 19.—The S.U. Carburetter.

In this device the flow of petrol past the jet is directly controlled by means of a needle. The suction in the induction pipe A operates through passage B upon the bellows C, which carries a needle D. As the throttle is opened the vacuum in the bellows C lifts the piston G and the needle D, and so allows an increased and correctly proportioned amount of petrol and air to flow into the induction pipe A. At starting and during slow running the piston G almost closes the air intake passage, giving a small choke tube effect upon the decreased jet area.



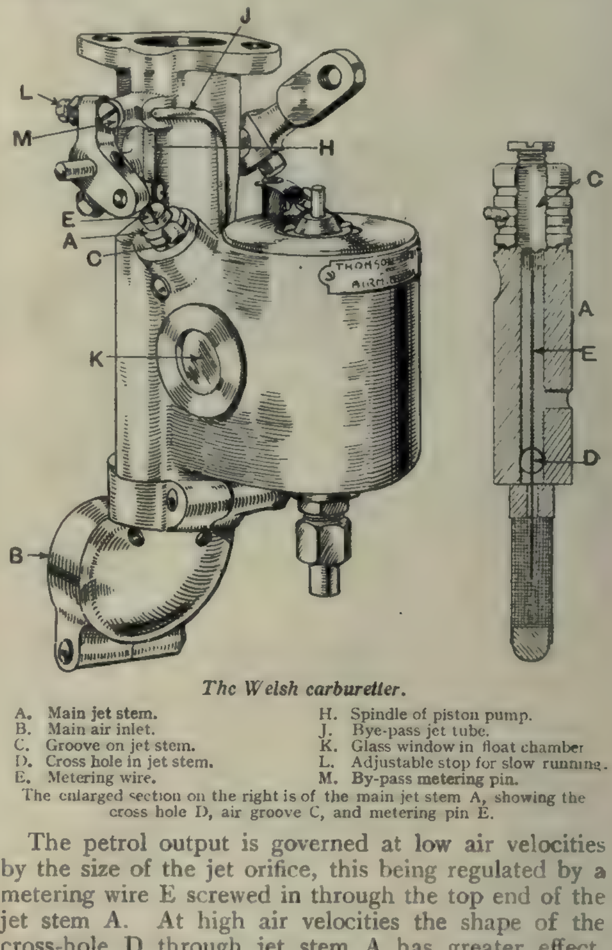
The S U. carburetter.

A. Induction pipe.
B. Connecting passage between induction pipe and bellows C.
C. Bellows.
D. Needle controlling petrol orifice
E. Air intake.
F. Guide for piston G.
G. Air control piston.
H. Throttle.
J. Petrol inlet.
K. Water jacket.

The S.U. Co., 386, Euston Road, London, N.W.

No. 20.—The Welsh Carburetter.

This is a single jet carburetter with a by-pass jet for slow running. The main jet A is inserted diagonally and is easily detached, carrying on its end the gauze tube through which the petrol passes on its way to the jet orifice. The jet discharges a fine spray of petrol into the throat of a choke or venturi tube through which the main air supply enters at B; air also flows down a groove C milled on the side of jet stem A and through a cross hole D, where it sprays the petrol as it issues from the jet orifice owing to the momenta of the petrol and air being balanced; no petrol issues from the jet unless there is air passing to vaporise it.



The Welsh carburetter.

A. Main jet stem.
B. Main air inlet.
C. Groove on jet stem.
D. Cross hole in jet stem.
E. Metering wire.
H. Spindle of piston pump.
J. Bye-pass jet tube.
K. Glass window in float chamber
L. Adjustable stop for slow running.
M. By-pass metering pin.

The enlarged section on the right is of the main jet stem A, showing the cross hole D, air groove C, and metering pin E.

The petrol output is governed at low air velocities by the size of the jet orifice, this being regulated by a metering wire E screwed in through the top end of the jet stem A. At high air velocities the shape of the cross-hole D through jet stem A has greater effect, as the particles of sprayed petrol crowd in the cross-hole D and retard the velocity, thus keeping down the output at high speeds.

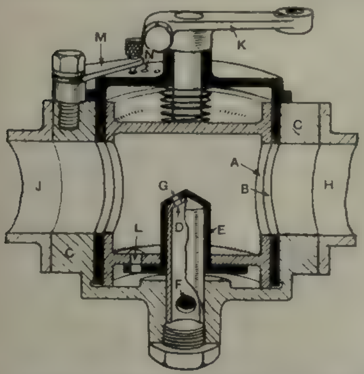
Acceleration is assisted by a piston pump, which, being inter-connected with the throttle spindle, lifts a charge of petrol as the throttle is opened, and supplements the supply from the main jet. As the piston rod H of the pump rises it cuts out the by-pass at about 15° of throttle opening. The by-pass jet tube J takes a supply of petrol from the main jet and delivers it into the induction pipe above the throttle valve. The window K is to enable the level of the spirit in the float chamber to be readily seen.

Thomson Bennett, Ltd., Cheapside, Birmingham.

No. 21.—The White and Poppe Carburetter.

This carburetter consists of two shells A and B, carried concentrically in a casing C. The jet D which protrudes through the bottom of the inner shell is covered by a thimble E, this thimble being carried by the inner shell A. The orifice in the top of the jet itself is drilled eccentrically with the centre line of the jet and registers with a jet orifice G in the thimble; it is, therefore, obvious that a slight rotation of the thimble has the effect of covering or uncovering the jet orifice D. Bearing this in mind, an understanding of the action of the carburetter should present no difficulty. On full throttle the shells A and B are so

placed that there is a clear passage through from the air inlet H to the induction pipe J as shown in the illustration. Petrol enters at F and flows through the jet orifice D and the corresponding orifice G in the thimble E, meeting air from the intake H and flowing into the induction pipe J. On throttling down by means of the lever K the inner shell A is rotated, and with it the thimble E by means of the pin L, thereby cutting down the petrol supply in proportion to the cutting down of the air supply, the diminution of the petrol supply being carried out as previously described, *i.e.*, by means of the eccentric jet orifices. A fine adjustment of the air supply for slow running is locked by the spring M, which registers in any one of the three holes N in the roof of the outer shell B. The position of this outer shell is varied by rotating it slightly in its casing, and its ultimate setting is locked by the pin on the extremity of M registering in one of the three holes N.



A vertical section of the White and Poppe carburetter.

A. Throttle shell carrying jet thimble E.
B. Slow running adjustment shell.
C. Casing.
D. Jet orifice.
E. Jet thimble.
F. Petrol supply.
G. Jet orifice in thimble E registering the jet orifice D.
H. Air inlet.
J. Induction pipe.
K. Throttle lever.
L. Pin by means of which shell A rotates thimble G.
M. Registering pin for shell B
N. Registering holes.

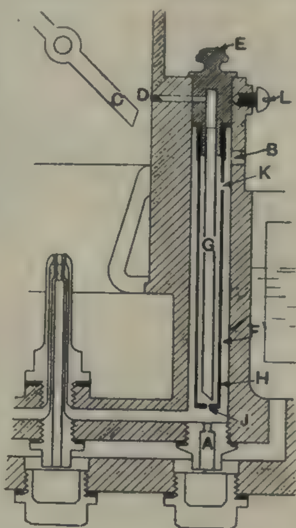
The more recent models of the W. and P. carburetter embody two interesting devices. The first is the elimination of the slight whistling noise which occurred at certain throttle positions by the introduction on the throttle valve of two small corrugated plates, which deflect the stream of air and prevent the production of any sound. The other improvement is the introduction of an acceleration lever, whereby the admission of air to the mixture can be adjusted with very great nicety to give the best possible results. This extra air so admitted is taken through the spindle of the throttle sleeve, the cam valve controlling the air being attached to the throttle lever and revolving with it. In addition to these adjustments the original one of altering the relation of the air port to the inlet port by a lever on the cover of the throttle chamber is still adhered to. Two types of the W. and P. carburetters are made, one as shown with a vertical throttle and the other with a horizontal throttle, which is more convenient for some designs of engines. The principle is exactly the same in both.

The same firm also supply a model which can be made to assume eight different positions with regard to the engine, a design which greatly facilitates fixing of the carburetter.

White and Poppe, Ltd., Coventry.

No. 22.—The Zenith Carburetter.

This carburetter has a double jet, the inner one being connected direct to the float chamber; the outer one is in connection with a tube into which petrol is allowed to flow through the orifice A. Subjected to the suction of the engine when the throttle C is nearly closed is a duct D which leads into and through the plug E, the latter being a push fit in the well F. The duct D communicates with a tube G bevelled at the bottom and lying within the intermediate tube H,



Part sectional view of the latest pattern Zenith carburetter showing slow-running attachment.

A. Plug with gauged petrol orifice.
B. Air inlet.
C. Butterfly throttle.
D. Petrol duct.
E. Plug carrying inner and intermediate tubes.
F. Petrol well.
G. Inner tube conveying mixture to duct D.
H. Intermediate tube with gauged petrol orifice J and air orifice K.
J. Gauged petrol orifice in intermediate tube H.
K. Gauged air orifice in intermediate tube H.
L. Set screw securing plug E.

which in its lower capped end has a gauged orifice J. When the engine is not running, or when it is running very slowly, the well F contains petrol to the height, approximately, of the petrol level in the float chamber. This supply of petrol finds its way from the float chamber through the gauged orifice in the plug A. When the engine is started it draws immediately upon the petrol in the intermediate tube H, and so obtains practically pure petrol, but after a few revolutions of the engine that source of supply is used up to be replenished at a definite rate by the liquid passing through the orifice J, air passing in at B and K to give the correct mixture. So long as the throttle is not opened and the engine is not run fast the slow running device supplies all the necessary mixture, but when the throttle is opened this source of supply cannot cope with the demand, and the main jets come into use. The slow running device is a feature of the Zenith carburetter, and the means of adjusting this device are also interesting, as variations of the air and petrol supplies can be made by determining the sizes of the holes J and K in the tube H.

The Zenith Carburetter Co., 40-42, Newman Street, London, W.

The Dewar Trophy.

The Dewar Trophy is awarded annually, by the Royal Automobile Club, for the best performance achieved up to October 15th in an R.A.C. observed trial. In 1908 the trophy was won by the Cadillac car in the standardisation and interchangeability test, and this car was also awarded the trophy in 1913 in a thousand miles road trial of a 1914 model. The Cadillac was fitted with a combined system of electric lighting, starting, and ignition, and had two gear ratios provided in the back axle by means of two direct-driving bevel wheels with electric gear change mechanism. In the trial the six standard R.A.C. routes were covered at an average speed of 19½ m.p.h., the fuel consumption being at the rate of 17.7 m.p.g. This is the only time the Dewar Trophy has been won twice by the same make of car.

The Fuel Question.

"Petrol Substitutes for use in Motor Vehicles."

COLONIAL motorists will have heard and read during the past twelve months a great deal about the "fuel question," brought about by the increase in the price of petrol and the subsequent search for a substitute in which benzole and alcohol have both played prominent parts. In order to keep readers abroad *au fait* with the present and true position of affairs in this respect, we feel that we cannot do better than reproduce the paper entitled "Petrol Substitutes for Motor Vehicles," prepared by Sir Boverton Redwood, Bart., and Prof. Vivian B. Lewes, and read before the Imperial Motor Transport Council in July, 1913.

The present high price of petrol, and the apprehension of increasing scarcity, with even higher resulting cost, have naturally directed attention to the question of possible substitutes, obtainable in adequate quantity at moderate cost.

It is obvious that any discussion of the subject which is to lead to practical results must be based upon an intelligent appreciation of all the factors, and accordingly the authors, in acceding to the request of the Executive Committee of the Imperial Motor Transport Conference to furnish a short paper that shall serve as a basis for discussion, propose to give, as an introduction, a *résumé* of the subject, as it presents itself to them.

What is Motor Spirit?

In order to prevent confusion, it may be well, in the first place, to define motor spirit as any easily evaporated combustible liquid sufficiently volatile to admit of the vapour forming an explosive mixture with air at moderate temperatures. This definition includes not only petrol, which may be described as that portion of crude petroleum which distils below 120° C., and has a specific gravity below, say, 0.75, but covers any liquid which meets the requirements indicated.

It may also be desirable, as a preliminary step, to dismiss from consideration the popular impression that the high price of petrol is mainly due to trade combinations and artificial restriction of output, and to recognise that the advance in cost has been directly brought about by the gigantic increase in consumption.

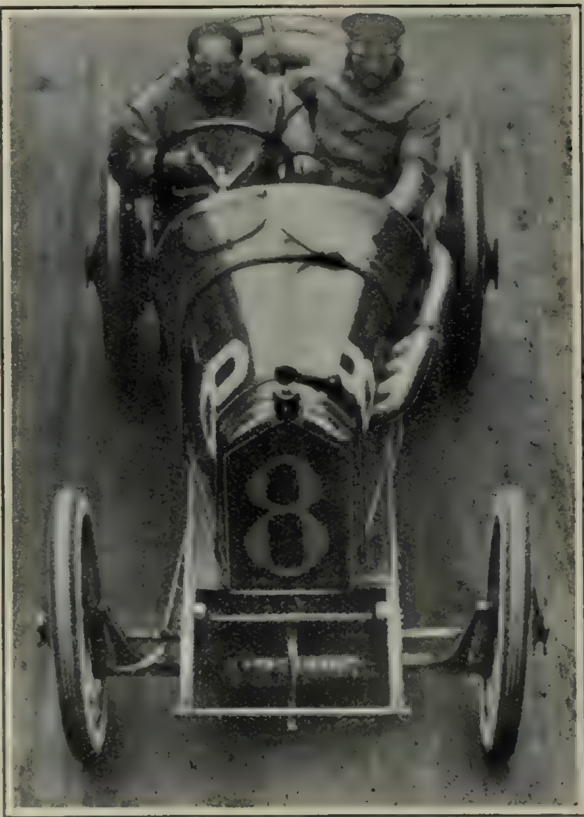
Since 1905 the imports of petrol into England have risen from eighteen to eighty million gallons, and it is probable that the consumption this year will amount to one hundred million gallons.

In America the demand has increased at an even greater rate, and the same conditions exist in all European countries. England, France, Spain, and, to a great extent, Germany, have no oil fields at home to supply the local demand, and are, therefore, dependent upon the surplus over and above that needed for home consumption in the countries that have oil fields. The eighty million gallons used in the British Isles last year were drawn from the following sources:

Dutch East Indies	46 million gallons.
America	16 ,, ,,
Russia	5 ,, ,,
Roumania	4 ,, ,,
Other countries	9 ,, ,,

so that more than half our supply came from the fields of the Royal Dutch and Shell Companies, whilst the American supply, which, up to five years ago, was our chief source of petrol, has now shrunk to one-fifth of the total.

Less than twenty years ago that portion of the crude oil distilling below 120° C. was chiefly used as a source of light and heat, and when it was first employed as a source of power its price was low. For a time the abundance of supplies and competition between the American and Dutch East Indian sources prevented any considerable advance, but as the rapidly progressive home consumption in America reduced the quantity available for shipment, competition grew weaker, and advantage was taken of the opportunity to place the market for petrol on a more profitable footing.



Boillot driving the three litre Peugeot to victory in the race for the Coupe de l'Auto on September 27th, 1913. He covered the 387 miles of rough and hilly course at an average speed of 63·15 miles an hour. Earlier in the year the same driver on a Peugeot of bigger horse power, won the Grand Prix.

With regard to the petrol supply, it must be borne in mind that last year the world's total production of crude oil amounted to fifty million tons, and that the growth in the production of crude oil has less than doubled itself since 1905, whilst the demand for petrol has more than quadrupled.

Variation of Supplies.

The amount of petrol to be obtained from the crude oil varies very greatly, some oils, such as the heavy petroleum of the Californian fields, being very poor in the lighter fractions, whilst the Roumanian and some of the Dutch East Indian fields yield an oil which gives a large fraction of the needed quality, and it would probably be fair to take the ratio of petrol to the world's crude oil supply at 10%. On this basis the eighty million gallons that we in this country used last year represent only about 2½% of the world's total production, but it is clear that with the demand growing so much faster than the production, competition for the petrol must become keener, and any lowering of the price in countries that do not themselves produce is extremely unlikely.

Another factor which has tended to increase the price of petrol has been that we have been suffering from insufficient transport facilities, but that the excess of demand over supply is the chief factor is shown by the price of crude oil at the fields.

In these circumstances it is of the highest importance to find some other source or sources for a considerable proportion of the motor spirit needed.

The only sources from which this is likely to be obtained are:

1. Those portions of crude petroleum other than the petrol fraction.
2. Products of the destructive distillation of coal and shale.
3. Products of fermentation.

Taking these in order, we will discuss first the yield of motor spirit from crude oil. Where oil exists it is usually accompanied by natural gas, which contains not only methane and traces of the other three gaseous members of

the paraffin series, but also traces of the vapour of pentane and hexane, and a very important advance has been made in condensing these liquid hydrocarbons out of the natural gas instead of either letting them escape freely into the atmosphere or burning them for the creation of power. Even with oils so poor in petrol as most of those of the Californian fields it is found that the natural gas contains enough hydrocarbon vapour to make it profitable to recover it by compressing the gas, when the vapour of such hydrocarbons as are liquid condense. In the Oklahoma and Kansas fields 12,500 gallons daily are recovered in this way, and the product, which is the lightest spirit obtainable, is becoming of great value for mixing with heavier grade petrols to give them the necessary volatility. This process is still in its infancy and will, undoubtedly, be extended to all the oilfields, yielding a very important addition to the petrol supply.

In studying the question of motor spirit one is led to the conclusion that the carburetter, which is the all-important factor, has received a smaller amount of attention than it deserves, and much may yet be done in the direction of making carburetters better adapted for use with the heavier grades of petroleum products. For many years past attempts have been made to use for motor purposes the fraction of petroleum having a specific gravity of about 0.8 which is usually employed as lighting oil, and many patents have been taken out for making motor spirits composed of such oil mixed with sufficient petrol to give the necessary volatility to start the engine.

A study of these patents reveals the fact that in most cases the patentee uses a mixture of about 40% of petrol with kerosene of a specific gravity of 0.8, and depends for the novelty of his invention upon the introduction of various substances intended to aid the *pro rata* evaporation of the heavier portions of the mixture. With several forms of carburetter on the market, such a mixture gives excellent results when used under uniform conditions, but it lacks the elasticity necessary for congested traffic, where constant slowing down, stopping and restarting are requisite, and is apt to give rise to starting troubles in cold weather. These objections have been met by providing a small supplementary feed-tank containing petrol, which is used for starting the engine and keeping it running until the system is warm, when the main tank, containing the mixture or even ordinary lighting oil of a specific gravity of 0.8, can be connected, and the running continues satisfactorily until the need for stopping occurs, after which the petrol is again turned on to give the necessary starting power. By the adoption of such methods the requirements of the public motor vehicle and trade waggon can be met, with a saving of 20% to 40% in the consumption of petrol.

A process which occupies a position of importance in increasing the production of motor spirit is that which is termed the "cracking" of oil. This term, which is an Americanism, was introduced in connection with the carburetting of water gas to render it fitted for distribution as an illuminating gas, and it is so good a term that it has been retained in speaking of the conversion of heavy oils into those of lower specific gravity and greater volatility. If one heats a hydrocarbon to a high temperature it is "broken up" into carbon and hydrogen, but if the temperature is so controlled as to prevent complete decomposition the hydrocarbon is not broken but "cracked" into lighter hydrocarbons.

In considering the nature of hydrocarbons we find that the simpler ones containing a small number of atoms to the molecule are gaseous, and that as more and more atoms of carbon and hydrogen become compressed into the molecule the congestion results in the compound assuming the liquid state, whilst further additions of the components lead eventually to its conversion into the solid form. It was shown by James Young in 1865 that when shale oil was distilled under pressure a large yield of lighter products could be obtained, and this was explained by Thorpe and Sidney Young in 1871, who showed that when paraffin wax was distilled under a pressure of 25 lbs. it could be converted into liquid products which contained hydrocarbons of the paraffin or saturated series and unsaturated hydrocarbons in nearly equal proportions. The same results were obtained in 1887 by Benton, who, however, employed higher pressures, whilst in 1889 Sir James Dewar and one of the authors showed that the distillation of heavy grade oils, when the distillates were condensed under pressure, resulted in an even larger increase in the more volatile constituents, a process which has been revived lately by the Standard Oil Company.

With the simple forms of hydrocarbons the process of cracking can unquestionably be employed with great success, and can be made to give an increase of between 30% and 40% in the lighter distillates. An admirable illustration of this process is found in the new oil refining system, in which those portions of the crude petroleum which come over after the petrol and lighting oils have been distilled off are employed for cracking in contact with iron and vaporising water, yielding a further 39% of excellent motor spirit. Such processes seem destined to play an important part in the immediate future in adding to our supply of motor spirit. Attempts are also being made to utilise the catalytic action of nickel in various forms in bringing about a combination of hydrogen with hydrocarbons containing a high percentage of carbon, so as to produce distillates of sufficiently low boiling point to form motor spirit.

The idea of cracking has been extended during the past few months from heavy hydrocarbon oils to the distillates obtained from coal, and one hears constantly of schemes in which the cracking of tar to produce light hydrocarbons is suggested as a possible and remunerative method of adding to the supply. When coal is subjected to destructive distillation it breaks up into gases, tar and ammonia liquor, which are volatilised and leave behind a residue of coke. The tar so produced varies widely in its character with the temperature at which the carbonisation has been carried on, the nature and condition of the coal, the form of retort and other factors.

All tar, however, can be classified under two broad headings:

1. Tar, the bulk of which has been distilled at temperatures above 800° C.
2. Tar, the bulk of which has been distilled below this temperature.

Class 1 includes the tar made in horizontal and inclined retorts during ordinary gasworks' practice, whilst

Class 2 consists of the tars from vertical and chamber retorts and low temperature processes.

The higher temperature tar is "benzenoid" in its character, and contains as its chief constituents benzene, toluene, carbolic and cresylic acids, naphthalene and anthracene, together with pitch containing much free carbon. All the above hydrocarbons belong to the ring form of structure, are high-temperature products, and when sufficiently heated to decompose break up chiefly to methane, hydrogen and carbon, so that this form of tar cannot be cracked profitably. The only possible treatment for this class of tar for the production of motor spirit is to distil off the benzene and toluene, which are the valuable portions for this purpose, and then to take the oil fractions and distil them through a column of red hot coke, when a small additional quantity of benzene and toluene is formed by the decomposition of the carbolic and cresylic acids in contact with the carbon surface. The cost of doing this, however, would be prohibitive, and it is only the fractions distilling from the tar direct that can be reckoned upon, and although something like fifteen million tons of coal are carbonised annually for gas-making in this country, it is only the largest works that distil their tar, and the quantity available for motor spirit would be only about 50,000 gallons per annum.

With vertical retorts a large percentage of the tar is distilled at a lower temperature, and becomes more paraffinoid in character, a slightly larger fraction being fitted for motor spirit, but at present such tars are generally mixed with those from horizontal retorts and are not available for separate distillation. Coke-oven tar is also of this character, and by scrubbing the gas with heavy oil to wash out the benzene vapour and distilling the tar, as much as three gallons of distillate fitted for use as motor spirit can be obtained per ton of coal.

True low temperature tars of the character yielded by destructive distillation below 500° C. are even more paraffinoid in character, and several processes have been brought forward lately for which it is claimed that about three gallons of motor spirit can be obtained by direct distillation of the tar from a ton of coal, and a further two to five gallons by cracking the naphtha distillates from the tar.

The latter claim is a somewhat doubtful one, but has been seized upon by the advocates of such processes, who boldly speak of seven gallons of motor spirit per ton from any small coal. In considering such claims, however, it should be remembered that although there may be a few coals in this country which, by careful treatment, fractionation of the tar, scrubbing of the gas, and cracking of the suitable distillates, might be made to yield this quantity, the cost of treatment probably outweighs the advantages.

At the present time there is no commercial process working on a large scale which will yield more than the three gallons per ton of coal carbonised that can be obtained from

coke oven practice, and the total amount of benzene so recovered will amount to about 8,000,000 gallons per annum, a large proportion of which is exported.

Much might be done in the direction of replacing the bee-hive coking ovens, that still exist to a very large extent in the North of England, by recovery ovens, but as matters at present stand the amount of benzene available is so small that any large demand would cause it to rise in price even more rapidly than petrol has done.

The Scotch shale oil industry is another source from which motor spirit might be obtained, but the 600,000 gallons which represent the annual output of distillates fitted for this purpose is only about 0.75% of the total petrol used last year, and a considerable proportion of this is marketed for solvent purposes. The heavier portions of the shale oil, however, lend themselves to cracking purposes, so that unless these fractions are all absorbed for fuel oil they might in the future prove a source of supply.

It must be borne in mind that any petrol substitutes made from petroleum, coal, or shale are only obtainable in a limited quantity, for in each case the store of raw material is in process of depletion. On the other hand, alcohol is a motor spirit which can be continuously manufactured in any required quantity, and if the Imperial Motor Transport Conference only realises this fact and uses its influence in the first place to stimulate the designing of an engine and carburetter best fitted for use with this liquid, and, secondly, to induce the Government to give the necessary facilities for the manufacture and use of methylated spirit for the purpose, it will have done much towards giving this country a home-produced source of power of which no foreign entanglements can rob us.

By fermentation in bulk, continuous distillation, and judicious methylation all the motor spirit needed can be obtained and sold at something like 1s. a gallon, and the extended researches of the United States Government have shown that engines can be satisfactorily run on alcohol, whilst in spite of the calorific inferiority of alcohol practically the same power is generated as with petrol, owing to the cooler cycle, smaller quantity of air required, and greater compression that can be used without fear of pre-ignition. Thousands of acres of land fitted for the growth of potatoes and beet are lying idle in Ireland and even in England, and when it is demonstrated to the satisfaction of the Government that the motor is ready for the new fuel, the required facilities could no longer be withheld.

Races and Hill-climbs.

The Principal Open Events of 1913 summarised, together with the Results of the same Events since they were instituted.

For Brooklands Records see pages 103-105. For World's Records confirmed by the International Association of Recognised Automobile Clubs see page 102.

The Targa Florio Race.

THIS event is held every year on a course in Sicily, and generally over a distance of 1,050 kilometres (656 miles). The 1913 race—run on May 11th—was won by Nazzaro, driving a Nazzaro car, in 19h. 28m. 40s.

WINNERS OF TARGA FLORIO RACE FROM 1906 TO 1913.

1906.—Cagno (Itala).
1907.—Nazzaro (F.I.A.T.)
1908.—Trucco (Isotta-Fraschini).
1909.—Cuippa (S.P.A.)
1910.—Cariolato (Franco).
1911.—Ceirano (S.C.A.T.)
1912.—Cyril Snipe (S.C.A.T.)
1913.—Nazzaro (Nazzaro).

The Indianapolis Race.

This important American race was held on the Indianapolis track, U.S.A., on May 30th, 1913. The track measures two and a half miles in circuit and ninety feet wide. The distance was 500 miles. There were twenty-eight competitors, among them Goux (Peugeot), the winner, Guyot (Sunbeam), Zuccarelli (Peugeot), and drivers of Mercédès, Isotta-Fraschini, Stutz, Mason, Henderson, Fox, Amel, Schacht, Mercer, Stearns-Knight, Tulsa, Case, Keeton, and Nyberg cars. The race up to 400 miles was a fight between Goux, Anderson (Stutz), and Mulford (Mercédès), Guyot having retired after covering 200 miles. The final result was:

		h. m. s.
1.	Goux (Peugeot)	6 41 43.45
2.	Wishart (Mercer)	6 45 6
3.	Merz (Stutz)	6 50 35.75
4.	Guyot (Sunbeam)	7 5 8.10
5.	Pilette (Mercédès-Knight)	7 19 25.55

The race is to be repeated in 1914, and promises to be of a still more international character.

The Shelsley Walsh Hill-climb.

The Shelsley Walsh Hill-climb, promoted by the Midland Automobile Club, is regarded as the event of the year in car hill-climbs. The 1913 event was the ninth successive occasion, and it was held on June 7th. The outstanding feature of the 1913 climb was that the previous record for fastest time was beaten no less than seven times. Mr. L. Hands (25 h.p. Talbot) made fastest time in the open event, and the first on formula was also a Talbot—the 15 h.p., driver Mr. H. G. Day.

SHELSLEY WALSH WINNERS FROM 1906 TO 1913.

Handicap formula.	Fastest time.	Secs.
1906.—T. W. Huband (Alldays).	F. A. Coleman (White Steam) ...	80.6
1907.—T. W. Bowen (Talbot).	J. E. Hutton (Berliet)	67.2
1908.—P. C. Kidner (Vauxhall).	S. F. Edge (Napier) ...	65.4
1909.—P. C. Kidner (Vauxhall).	H. C. Holder (Daimler)	68.4
1910.—R. Lisle (Star).	O. S. Thompson (Austin) ...	70.2
1911.—P. C. Kidner (Vauxhall).	H. C. Holder (Daimler)	63.4
1912.—C. Bianchi (Crossley).	J. Higginson (La Buire)	68.8
1913.—H. G. Day (Talbot).	L. Hands (Talbot) ...	57⅕
CYCLE CARS.		
1913.—G. W. Hands (Calthorpe).	W. D. South (Morgan)	91⅘

The Grand Prix.

This great French event took place on July 12th, 1913, over the Picardie Circuit near Amiens. The course, about twenty miles in length, was covered twenty-nine times, the exact distance being 916.8 kilometres = 569.33 miles. The Peugeot firm won and won handsomely, taking first and second places. Great Britain was third and sixth with two Sunbeam cars. The race started at 5.31 a.m., and twenty competitors actually took part.

The race was a battle between Peugeot, Sunbeam, and Delage, the final result being a win for the almost invincible Peugeot driven by Boillot, another Peugeot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was second driven by Goux, and then came Chassagne's Sunbeam and Bablot's Delage. The winner's average speed worked out at 72.2 m.p.h., which was an improvement on 1912, when Boillot won also on a Peugeot at an average speed of 68.45 m.p.h. on the Dieppe course, the distance then being 956 miles.

In 1912 the Grand Prix (unlimited) and the Coupe de l'Auto (limited) were run on the same day and simultaneously. The Coupe de l'Auto competitors were limited to three litres (3,000 c.c.) capacity, and the winning Sunbeam (Rigal) of 2,990 c.c. accomplished 65.29 m.p.h., only 3.16 m.p.h. slower than the Peugeot, which had an engine of 7,600 c.c. Below we give the results of the 1912 combined races, and the results of the unlimited Grand Prix of 1913. Further on will be found the results of the 1913 Coupe de l'Auto, which are interesting when compared with the 1912 particulars given below.

1912 GRAND PRIX AND COUPE DE L'AUTO RESULTS.

Order in Unlimited Class.	Driver and Car.	Order in Limited Class.	Time.	Speed.
			h. m. s.	m.p.h.
1	Boillot, Peugeot	–	13 58 $2\frac{3}{5}$	68.45
2	Wagner, F.I.A.T. ...	–	14 11 $8\frac{2}{5}$	67.32
3	Rigal, Sunbeam	1	14 38 36	65.29
4	Resta, Sunbeam	[illegible]	14 39 $51\frac{4}{5}$	65.23
5	Médinger, Sunbeam..	3	15 59 $41\frac{2}{5}$	59.78

1913 GRAND PRIX RESULTS.
(Unlimited.)

Order.	Driver and Car.	Time.	Speed.
		h. m. s.	m.p.h.
1	Boillot, Peugeot	7 53 $56\frac{4}{5}$	72.2
2	Goux, Peugeot	7 56 $22\frac{1}{5}$	71.8
3	Chassagne, Sunbeam	8 6 $20\frac{1}{5}$	70.3
4	Bablot, Delage	8 16 $13\frac{3}{5}$	68.9
5	Guyot, Delage	8 17 $58\frac{4}{5}$	68.6
6	Resta, Sunbeam	8 21 $38\frac{3}{5}$	68.1

Previous Grand Prix races have resulted as follow:

Year.	Driver and Country.	Car.	Distance.	Average Speed.
			miles	m.p.h.
1906	Sisz, France	Renault	750	63.0
1907	Nazzaro, Italy	F.I.A.T.	477	70.5
1908	Lautenschlager, Germany	Mercédès	477	69.0

There were no races in 1909, 1910, and 1911.

The 1914 Grand Prix promises to be even more important than its predecessor. The entry list is a large one and very representative of the best firms making racing cars. Five nations will take part in addition to Britain, viz., France, Germany, Belgium, Italy, and Switzerland.

The race will be held on July 4th near Lyons over a total distance of 470 miles. Once round the course measures 23.5 miles, and this will have to be covered twenty times. The principal regulations are that competing cars must not exceed a maximum unladen weight of 1,100 kilos (1 ton 1 cwt. 2 qrs. 12 lbs.), and that the engine capacity must not exceed 4,500 c.c. (a four-cylinder engine of 101×140 c.c. = 4,486 c.c.)

The following list of entries is complete, entries having finally closed on March 31st. The last two cars, Cæsar and Nazzaro, were entered at the last minute, entrants paying double fees.

ENTRIES FOR 1914 GRAND PRIX.

1. Alda (Tabuteau). F.
2. Peugeot (Boillot). F.
3. Peugeot (Goux). F.
4. Peugeot (Rigal). F.
5. Sunbeam (Resta). B.
6. Sunbeam (Chassagne). B.
7. Sunbeam (Lee Guinness). B.
8. Nazzaro (Nazzaro). I.
9. Opel (Joerns). G.
10. Opel. G.
11. Opel. G.
12. Mercédès (Lautenschlager). G.
13. Mercédès (Pilette). G.
14. Mercédès (Salzer). G.
15. Mercédès (Nagel). G.
16. Mercédès (Seiler). G.
17. Cæsar. I.
18. Alda. F.
19. Aquila-Italiana (Marsaglia). I.
20. Aquila-Italiana. I.
21. Aquila-Italiana. (d'Argentina). I.
22. Nagant. Be.
23. Nagant. Be.
24. Alda. F.
25. Vauxhall. B.
26. Vauxhall. B.
27. Vauxhall. B.
28. Th. Schneider (Champoiseau). F.
29. Th. Schneider. F.
30. Th. Schneider. F.
31. Delage (Bablot). F.
32. Delage (Guyot). F.
33. Delage. F.
34. Nazzaro. I.
35. Piccard-Pictet. S.
36. Piccard-Pictet. S.
37. F.I.A.T. (Wagner). I.
38. F.I.A.T. (Cagno). I.
39. F.I.A.T. I.
40. Cæsar. I.
41. Nazzaro (Constantini). I.

F. signifies France, B. Britain, I. Italy, Be. Belgium, S. Switzerland, and G. Germany.

The names of the probable drivers where these are known are given after each car.

The 1913 French Three Litre Race.

This event for the *L'Auto* Cup was held on the Boulogne Circuit on Sunday, September 21st, and was open to cars with engines not exceeding 3,000 c.c., and a maximum weight limit of 17 cwts. 2 qrs. 20 lbs. =900 kilos. The distance was twelve times round the course, or 387 miles. There were seventeen starters out of an entry of twenty-five. Result:

		h. m. s.	Speed, m.p.h.
1.	Boillot (Peugeot)	6 7 $40\frac{4}{5}$	... 63.15
2.	Goux (Peugeot)	6 16 $3\frac{3}{5}$	... 61.91
3.	Lee Guinness (Sunbeam)...	6 18 $50\frac{3}{5}$	... 61.45
4.	Hancock (Vauxhall) ...	6 58 18	... 55.52
5.	Rigal (Peugeot)	6 59 $44\frac{4}{5}$	... 55.32
6.	Tabuteau (Alda)	7 52 $34\frac{2}{5}$	... 49.13
7.	D'Avaray (Anasagasti) ...	8 7 25	... 47.64

The Sarthe Circuit.

Le Mans was the scene of the Sarthe Circuit. The race was run off on August 5th, 1913. The Amiens Peugeots had been entered but were scratched two days before the race. The Mercédès put up a good performance, finishing third, fourth, sixth, and seventh out of a field of fifteen. There were no British entries. Another event was run at the same time, the Sarthe Cup for cars with engines not exceeding 3,000 c.c., but there were only four entries—two Vinots, a Grégoire, and a Crespelle. The Grégoire won this, completing the 335.1 miles in 5h. 47m. 48s. = 64.2 m.p.h. The results of the bigger event were:

		Time, h. m. s.
1.	Bablot (Delage)	4 21 $50\frac{4}{5}$
2.	Guyot (Delage)	4 26 30
3.	Pilette (Mercédès)	4 27 $55\frac{3}{5}$
4.	Salzer (Mercédès)	4 34 55
5.	Duray (Delage)	4 35 $3\frac{3}{5}$
6.	Lautenschlager (Mercédès)	5 13 $15\frac{3}{5}$

Winners of Gordon-Bennett Races.

Although the international Gordon-Bennett Race is now defunct, its place having been taken by the Grand Prix, the results of the annual races for the G.B. Cup which were held from its institution until it was superseded in 1906 are worthy of record:

Year.	Driver and Country.	Car.	Distance.	Average Speed.
			miles.	m.p.h.
1900	Charron, France	Panhard	352	38.6
1901	Girardot, France	Panhard	351	37.0
1902	Edge, Great Britain	Napier	367	31 8
1903	Jenatzy, Germany	Mercédès	368	49.2
1904	Théry, France	Brasier	351	54.5
1905	Théry, France	Brasier	341.5	48.5

World's Records.

Created since the Session of the International Association of Recognised Automobile Clubs, December, 1912, and accepted by the Association at its Session held at Paris on 25th October, 1913.

	Date.	Description of Car. Make.	Weight. lbs.	No. of Cyls.	Size of Cylinders. Bore	and Stroke.	Total Cubic Capacity.	Performance. Distance. mls.	yds.	Time. hrs.	mins.	secs.	Speed. M.P.H.
50 miles	8. 2.13	Talbot	2540	4	101.5	140	4531	50	–		29	10.50	102.83
	15. 2.13	Talbot	2540	4	101.5	140	4531	50	—		29	2.50	103.30
	12. 4.13	Peugeot	3220	4	110	200	7603	50	–		28	18.65	105.97
	10.10.13	Sunbeam	3207	12	80	150	9048	50	–		27	40.87	108.38
100 miles	15. 2.13	Talbot	2540	4	101.5	140	4531	100	—		57	49.38	103.76
	12. 4.13	Peugeot	3220	4	110	200	7603	100	–		56	29.93	106.20
	10.10.13	Sunbeam	3207	12	80	150	9048	100	—		55	35.55	107.93
150 miles	12. 4.13	Peugeot	3220	4	110	200	7603	150	–	1	28	35.67	101.59
	10.10.13	Sunbeam	3207	12	80	150	9048	150	—	1	25	14.94	105.57
200 miles	1.10.13	Sunbeam	2601	6	80	150	4524	200	—	2	5	6.28	95.92
300 miles	30. 8.13	Vauxhall	2549	4	95	140	3969	300	—	3	15	24.72	92.11
	1.10.13	Sunbeam	2601	6	80	150	4524	300	—	3	7	45.46	95.87
400 miles	30. 8.13	Vauxhall	2549	4	95	140	3969	400	—	4	21	14.99	91.90
	1.10.13	Sunbeam	2601	6	80	150	4524	400	—	4	12	15.08	95.14
500 miles	30. 8.13	Vauxhall	2549	4	95	140	3969	500	—	5	34	10.34	89.77
	1.10.13	Sunbeam	2601	6	80	150	4524	500	–	5	16	40.01	94.74
600 miles	27. 5.13	Argyll	2726	4	80	130	2614	600	–	7	40	49.63	78.12
	30. 8.13	Vauxhall	2549	4	95	140	3969	600	—	6	46	57.27	88.46
	1.10.13	Sunbeam	2601	6	80	150	4524	600	—	6	22	54.16	94.02
700 miles	27. 5.13	Argyll	2726	4	80	130	2614	700	–	9	6	53.76	76.80
	30. 8.13	Vauxhall	2549	4	95	140	3969	700	–	7	58	42.74	87.74
	1.10.13	Sunbeam	2601	6	80	150	4524	700	—	7	29	36.55	93.41
800 miles	27. 5.13	Argyll	2726	4	80	130	2614	800	—	10	28	14.67	76.40
	1.10.13	Sunbeam	2601	6	80	150	4524	800	–	8	34	25.15	93.21
900 miles	27. 5.13	Argyll	2726	4	80	130	2614	900	—	11	49	18.61	76.13
	1.10.13	Sunbeam	2601	6	80	150	4524	900	—	9	53	22.29	91.00
1000 miles	27. 5.13	Argyll	2726	4	80	130	2614	1000	—	13	5	45.68	76.36
	1.10.13	Sunbeam	2601	6	80	150	4524	1000	—	11	6	38.87	90.00
1 hour	15. 2.13	Talbot	2560	4	101.5	140	2560	103	1470	1	–	–	103.84
	12. 4.13	Peugeots	3220	4	110	200	7603	106	387	1	–		106.22
	10.10.13	Sunbeam	3207	12	80	150	9048	107	1672	1	–	–	107.95
2 hours	1.10.13	Sunbeam	2601	6	80	150	4524	195	189	2	—		97.55
3 hours	1.10.13	Sunbeam	2601	6	80	150	4524	287	856	3	–	–	95.83
4 hours	30. 8.13	Vauxhall	2549	4	95	140	3969	366	1025	4	–	–	91.64
	1.10.13	Sunbeam	2601	6	80	150	4524	380	628	4	—	–	95.09
5 hours	30. 8.13	Vauxhall	2549	4	95	140	3969	456	840	5	—	–	91.30
	1.10.13	Sunbeam	2601	6	80	150	4524	473	464	5	—		94.65
6 hours	30. 8.13	Vauxhall	2549	4	95	140	3969	541	100	6	—	—	90.18
	1.10.13	Sunbeam	2601	6	80	150	4524	566	589	6	–	–	94.39
7 hours	27. 5.13	Argyll	2726	4	80	130	2614	544	1171	7	–	–	77.81
	30. 8.13	Vauxhall	2549	4	95	140	3969	620	320	7	–		88.60
	1.10.13	Sunbeam	2601	6	80	150	4524	653	147	7	–	–	93.29
8 hours	27. 5.13	Argyll	2726	4	80	130	2614	622	523	8	–	–	77.79
	30. 8.13	Vauxhall	2549	4	95	140	3969	702	28	8	–		87.76
	1.10.13	Sunbeam	2601	6	80	150	4524	748	247	8			93.51
9 hours	27. 5.13	Argyll	2726	4	80	130	2614	690	1284	9	–	—	76.74
	30. 8.13	Vauxhall	2549	4	95	140	3969	749	1318	9	—	–	83.31
	1.10.13	Sunbeam	2601	6	80	150	4524	840	1533	9	–		93.43
10 hours	27. 5.13	Argyll	2726	4	80	130	2614	766	1504	10		—	76.69
	1.10.13	Sunbeam	2601	6	80	150	4524	910	969	10	—	–	91.06
11 hours	27. 5.13	Argyll	2726	4	80	130	2614	837	598	11	–	—	76.12
	1.10.13	Sunbeam	2601	6	80	150	4524	989	828	11	–	–	89.95
12 hours	27. 5.13	Argyll	2726	4	80	130	2614	914	604	12	–	–	76.20
	1.10.13	Sunbeam	2601	6	80	150	4524	1078	460	12	–	—	89.85
13 hours	27. 5.13	Argyll	2726	4	80	130	2614	992	483	13	–	–	76.33
14 hours	19. 5.13	Argyll	2726	4	80	130	2614	1016	437	14	–	—	72.59
	27. 5.13	Argyll	2726	4	80	130	2614	1070	57	14	—	—	76.43
								Kilometres.					K.P.H.
50 kiloms.	10.10.13	Sunbeam	3207	12	80	150	9048	50			17	9.13	174.90
100 kiloms.	10.10.13	Sunbeam	3207	12	80	150	9048	100			34	25.54	174.29
150 kiloms.	10.10.13	Sunbeam	3207	12	80	150	9048	150			51	44.42	173.95
200 kiloms.	10.10.13	Sunbeam	3207	12	80	150	9048	200		1	10	39.12	169.85
250 kiloms.	1.10.13	Sunbeam	2601	6	80	150	4524	250		1	35	43.14	156.71
300 kiloms.	1.10.13	Sunbeam	2601	6	80	150	4524	300		1	54	40.72	156.96
400 kiloms.	1.10.13	Sunbeam	2601	6	80	150	4524	400		2	34	51.55	154.98
500 kiloms.	1.10.13	Sunbeam	2601	6	80	150	4524	500		3	14	24.38	154.31
600 kiloms.	1.10.13	Sunbeam	2601	6	80	150	4524	600		3	55	17.34	153.00
700 kiloms.	1.10.13	Sunbeam	2601	6	80	150	4524	700		4	35	59.76	152.16
800 kiloms.	1.10.13	Sunbeam	2601	6	80	150	4524	800		5	14	50.27	152.45
900 kiloms.	1.10.13	Sunbeam	2601	6	80	150	4524	900		5	55	36.08	151.85
1000 kiloms.	1.10.13	Sunbeam	2601	6	80	150	4524	1000		6	36	22.80	151.35
1100 kiloms.	1.10.13	Sunbeam	2601	6	80	150	4524	1100		7	19	11.68	150.24
1200 kiloms.	1.10.13	Sunbeam	2601	6	80	150	4524	1200		7	58	23.24	150.51
1300 kiloms.	1.10.13	Sunbeam	2601	6	80	150	4524	1300		8	39	17.45	150.20
1400 kiloms.	1.10.13	Sunbeam	2601	6	80	150	4524	1400		9	21	13.88	149.67
1500 kiloms.	1.10.13	Sunbeam	2601	6	80	150	4524	1500		10	13	21.66	146.73
1600 kiloms.	1.10.13	Sunbeam	2601	6	80	150	4524	1600		11	2	55.86	144.81
1700 kiloms.	1.10.13	Sunbeam	2601	6	80	150	4524	1700		11	45	54.02	144.50

All the above were accomplished from a standing start.

Since the publication of the table on the previous page several records have been beaten by Hornsted on the 200 h.p. Benz car; but as records may be beaten and yet are not entitled to be termed world's records until they have been passed by the Association of Clubs in Paris they cannot be added to the table, and are given below.

It is also of interest to note that the International Federation now insists that all short-distance records must be made in both directions, and that the record figure must be the mean of the time of the two best performances over the same distance on the same occasion. Hornsted's records as below are the first to be made under the new conditions.

Date	Driver and Car.	Distance.	Time.	Speed.
			m s.	m.p.h.
Dec. 22/'13	L. G. Hornsted (200 h.p. Benz)	Kilometre (s.s.)	30.405	73 57
Jan. 22/'14	L. G. Hornsted (200 h.p. Benz)	½ mile (s.s.) .	25.265	71.25
Jan. 22/'14	L. G. Hornsted (200 h.p. Benz)	1 mile (s.s.) ..	41.21	87.34
Jan. 14/'14	L. G. Hornsted (200 h.p. Benz)	2 miles (f.s.) .	58.99	122.05
Jan. 14/'14	L. G. Hornsted (200 h.p. Benz)	5 miles (f.s.) .	2 35.08	116.08
Jan. 22/'14	L. G. Hornsted (200 h.p. Benz)	10 miles (f.s.) .	5 19.78	112.57

Hornsted made seven runs in opposite directions in his attempts on the mile standing start, the best time for the mile in the normal direction being the last accomplished in 41.26s.; the best time in the reverse direction was the fifth, done in 41.16s. The mean of these times is 41.21s., beating Hemery's long-standing record of 41.268s. made in the one direction. The speed in Hornsted's case is equal to a mean of 87.34 m.p.h. against Hemery's 87.234 m.p.h.

In Hornsted's ten miles record the timing strips were arranged so that during the five laps he completed Major Lloyd, the timekeeper, was able to secure the times for ten distinct half miles, five runs of two miles, seven of five miles, and three of ten miles.

The times for the five laps were: First, 86.75s.; second, 87.12s.; third, 87.60s.; fourth, 90.87s.; and fifth, 90.88s.

The best time for the mile = 119.72 m.p.h., as against Hemery's record of 115.92 done in one direction only.

Brooklands Cubic Capacity Classes (Instituted 1912).

Distance.	Holder.	Driver.	Car and Engine Size.	Time or Distance.	Speed M.P.H.,
A.—MAXIMUM CAPACITY, 100 CUBIC INCHES, OR 1,639 CUBIC CENTIMETRES.					
				h. m. s.	
½-mile (flying start)	W. Turner Smith ..	W. Turner Smith	Stoewer, 75 × 89, 1,573 c.c.	26.60	67.67
Kilometre (flying start) ..	W. Turner Smith ..	W. Turner Smith	Stoewer, 75 × 89, 1,573 c.c.	33.07	67.64
Mile (flying start)	W. Turner Smith ..	W. Turner Smith	Stoewer, 75 × 89, 1,573 c.c.	53.28	67.56
10 laps (standing start) ..	W. Turner Smith ..	W. Turner Smith	Stoewer, 75 × 89, 1,573 c.c.	25 3.79	65.07
B.—MAXIMUM CAPACITY, 125 CUBIC INCHES, OR 2,048 CUBIC CENTIMETRES.					
½-mile (flying start)	W. O. Bentley	W. O. Bentley	D.F.P., 70 × 130, 2,001 c.c.	20.07	89.70
Kilometre (flying start) ..	W. O. Bentley	W. O. Bentley	D.F.P., 70 × 130, 2,001 c.c.	25.06	89.26
Mile (flying start)	W. O. Bentley	W. O. Bentley	D.F.P., 70 × 130, 2,001 c.c.	41.05	87.07
10 laps (standing start) ..	W. O. Bentley	W. O. Bentley	D.F.P., 70 × 130, 2,001 c.c.	20 14.97	81.98
50 miles (standing start)	W. O. Bentley	W. O. Bentley	D.F.P., 70 × 130, 2,001 c.c.	36 29.81	82.20
100 miles ,,	W. G. Tuck	W. G. Tuck	Humber, 70.4 × 130, 2,024 c.c.	1 19 2.74	75.90
150 miles ,,	W. G. Tuck	W. G. Tuck	Humber, 70.4 × 130, 2,024 c.c.	2 13 56.71	67.19
200 miles ,,	W. G. Tuck	W. G. Tuck	Humber, 70.4 × 130, 2,024 c.c.	2 57 5.57	67.76
300 miles ,,	T. C. Pullinger	J. Reid	Arrol-Johnston, 69.3 × 120, 1,810 c.c.	4 54 36.46	61.10
50 kilometres ,,	W. O. Bentley	W. O. Bentley	D.F.P., 70 × 130, 2,001 c.c.	22 41.42	132.21*
100 kilometres ,,	W. O. Bentley	W. O. Bentley	D.F.P., 70 × 130, 2,001 c.c.	45 20.35	132.34*
150 kilometres ,,	W. O. Bentley	W. O. Bentley	D.F.P., 70 × 130, 2,001 c.c.	1 8 25.74	131.52*
				mls. yds.	
1 hour (standing start) ..	W. O. Bentley	W. O. Bentley	D.F.P., 70 × 130, 2,001 c.c.	82 256	82.15
2 hours ,, ..	W. G. Tuck	W. G. Tuck	Humber, 70.4 × 130, 2,024 c.c.	136 134	68.04
3 hours ,, ..	W. G. Tuck	W. G. Tuck	Humber, 70.4 × 130, 2,024 c.c.	203 546	67.77
4 hours ,, ..	W. G. Tuck	W. G. Tuck	Humber, 70.4 × 130, 2,024 c.c.	272 1606	68.23
5 hours ,, ..	T. C. Pullinger	J. Reid	Arrol-Johnston, 69.3 × 120, 1,810 c.c.	305 1146	61.13
6 hours ,, ..	T. C. Pullinger	J. Reid	Arrol-Johnston, 69.3 × 120, 1,810 c.c.	368 742	61.40
C.—MAXIMUM CAPACITY, 150 CUBIC INCHES, OR 2,458 CUBIC CENTIMETRES.					
				h. m. s.	
½-mile (flying start)	L. Coatalen	T. Hearn	Sunbeam, 80 × 120, 2,413 c.c.	20.70	86.96
Kilometre (flying start) ..	C. Benson	W. G. Tuck	Humber, 75 × 130, 2,297 c.c.	30.05	74.44
Mile (flying start)	C. Benson	W. G. Tuck	Humber, 75 × 130, 2,297 c.c.	48.41	74.32
10 laps (standing start) ..	L. Coatalen	L. Coatalen	Sunbeam, 80 × 120, 2,413 c.c.	20 6.57	82.55
D.—MAXIMUM CAPACITY, 175 CUBIC INCHES, OR 2,868 CUBIC CENTIMETRES.					
½-mile (flying start)	L. R. L. Squire ...	R. S. Witchell	Straker-Squire, 87 × 120, 2,853 c.c.	18.23	98.74
Kilometre (flying start) ..	L. R. L. Squire ...	R. S. Witchell	Straker-Squire, 87 × 120, 2,853 c.c.	22.84	97.94
Mile (flying start)	L. R. L. Squire ...	R. S. Witchell	Straker-Squire, 87 × 120, 2,853 c.c.	37.35	96.39
10 laps (standing start) ..	L. R. L. Squire ...	R. S. Witchell	Straker-Squire, 87 × 120, 2,853 c.c.	18 0.28	92.21
50 miles (standing start	L. R. L. Squire ...	R. S. Witchell	Straker-Squire, 87 × 120, 2,853 c.c.	32 36.16	92.02
100 miles ,,	H. G. Perrot	W. G. Scott	Argyll, 80 × 130, 2,614 c.c.	1 16 32.78	78.38
150 miles ,, ..	H. G. Perrot	W. G. Scott	Argyll, 80 × 130, 2,614 c.c.	1 54 36.42	78.53
200 miles ,, ..	H. G. Perrot	W. G. Scott & L. G. Hornsted	Argyll, 80 × 130, 2,614 c.c.	2 34 23.15	77.73
300 miles ,, ..	H. G. Perrot	W. G. Scott & L. G. Hornsted	Argyll, 80 × 130, 2,614 c.c.	3 48 46.75	78.68
400 miles ,, ..	H. G. Perrot	W. G. Scott & L. G. Hornsted	Argyll, 80 × 130, 2,614 c.c.	5 8 31.59	77.79
500 miles ,, ..	H. G. Perrot	W. G. Scott & L. G. Hornsted	Argyll, 80 × 130, 2,614 c.c.	6 26 22.74	77.64
600 miles ,, ..	H. G. Perrot	W. G. Scott & L. G. Hornsted	Argyll, 80 × 130, 2,614 c.c.	7 40 49.63	78.12
700 miles ,, ..	H. G. Perrot	W. G. Scott & L. G. Hornsted	Argyll, 80 × 130, 2,614 c.c.	9 6 53.76	76.80
800 miles ,, ..	H. G. Perrot	W. G. Scott & L. G. Hornsted	Argyll, 80 × 130, 2,614 c.c.	10 28 14.67	76.40
900 miles ,, ..	H. G. Perrot	W. G. Scott & L. G. Hornsted	Argyll, 80 × 130, 2,614 c.c.	11 49 18.61	76.13
1000 miles ,, ..	H. G. Perrot	W. G. Scott & L. G. Hornsted	Argyll, 80 × 130, 2,614 c.c.	13 5 45.68	76.36
				mls. yds.	
1 hour (standing start)	H. G. Perrot	W. G. Scott	Argyll, 80 × 130, 2,614 c.c.	78 503	78.29
2 hours ,, ..	H. G. Perrot	W. G. Scott	Argyll, 80 × 130, 2,614 c.c.	157 207	78.56
3 hours ,, ..	H. G. Perrot	W. G. Scott & L. G. Hornsted	Argyll, 80 × 130, 2,614 c.c.	234 635	78.12
4 hours ,, ..	H. G. Perrot	W. G. Scott & L. G. Hornsted	Argyll, 80 × 130, 2,614 c.c.	315 37	78.76
5 hours ,, ..	H. G. Perrot	W. G. Scott & L. G. Hornsted	Argyll, 80 × 130, 2,614 c.c.	388 1177	77.73
6 hours ,, ..	H. G. Perrot	W. G. Scott & L. G. Hornsted	Argyll, 80 × 130, 2,614 c.c.	466 1636	77.82
7 hours ,, ..	H. G. Perrot	W. G. Scott & L. G. Hornsted	Argyll, 80 × 130, 2,614 c.c.	544 1171	77.81
8 hours ,, ..	H. G. Perrot	W. G. Scott & L. G. Hornsted	Argyll, 80 × 130, 2,614 c.c.	622 523	77.79
9 hours ,, ..	H. G. Perrot	W. G. Scott & L. G. Hornsted	Argyll, 80 × 130, 2,614 c.c.	690 1284	76.74
10 hours ,, ..	H. G. Perrot	W. G. Scott & L. G. Hornsted	Argyll, 80 × 130, 2,614 c.c.	766 1504	76.69
11 hours ,, ..	H. G. Perrot	W. G. Scott & L. G. Hornsted	Argyll, 80 × 130, 2,614 c.c.	837 598	76.12
12 hours ,, ..	H. G. Perrot	W. G. Scott & L. G. Hornsted	Argyll, 80 × 130, 2,614 c.c.	914 604	76.20
13 hours ,, ..	H. G. Perrot	W. G. Scott & L. G. Hornsted	Argyll, 80 × 130, 2,614 c.c.	992 483	76.33
14 hours ,, ..	H. G. Perrot	W. G. Scott, L. G. Hornsted, and J. H. Toon	Argyll, 80 × 130, 2,614 c.c.	1070 57	76.43

* Kilometres per hour.

Brooklands Cubic Capacity Classes (continued).

E.—MAXIMUM CAPACITY, 235 CUBIC INCHES, OR 3,851 CUBIC CENTIMETERS.

Distance.	Holder.	Driver.	Car and Engine Size.	Time or Distance.	Speed. M.P.H.
				h. m. s.	
½-mile (flying start)	H. Boissy	Jules Goux	Peugeot, 78 × 156, 2,982 c.c.	16.95	106.19
Kilometre (flying start)	H. Boissy	Jules Goux	Peugeot, 78 × 156, 2,982 c.c.	21.14	105.81
Mile (flying start)	H. Boissy	Jules Goux	Peugeot, 78 × 156, 2,982 c.c.	34.17	105.36
10 laps (standing start)	H. Boissy	Jules Goux	Peugeot, 78 × 156, 2,982 c.c.	16 29.35	100.68
50 miles (standing start)	P. C. Kidner	A. J. Hancock	Vauxhall, 90 × 118, 3,002 c.c.	30 52.74	97.15
100 miles ,,	L. Coatalen	R. F. L. Crossman	Sunbeam, 80 × 149, 2,996 c.c.	1 14 41.0	80.34
150 miles ,,	R. Lisle	R. Lisle	Star, 90 × 150, 3,817 c.c.	1 53 41.0	79.17
200 miles ,,	L. Coatalen	R. F. L. Crossman & D. Resta	Sunbeam, 80 × 149, 2,996 c.c.	2 30 32.6	79.71
300 miles ,,	L. Coatalen	R. F. L. Crossman & D. Resta	Sunbeam, 80 × 149, 2,996 c.c.	3 45 53.5	79.68
400 miles ,,	R. Lisle	R. Lisle	Star, 90 × 150, 3,817 c.c.	5 1 29.85	79.60
500 miles ,,	R. Lisle	R. Lisle	Star, 90 × 150, 3,817 c.c.	6 20 43.72	78.80
600 miles ,,	R. Lisle	R. Lisle	Star, 90 × 150, 3,817 c.c.	7 35 30.74	79.03
700 miles ,,	L. Coatalen	R. F. L. Crossman & D. Resta	Sunbeam, 80 × 149, 2,996 c.c.	9 23 41.2	74.51
800 miles ,,	L. Coatalen	R. F. L. Crossman & D. Resta	Sunbeam, 80 × 149, 2,996 c.c.	10 39 5.7	75.11
900 miles ,,	L. Coatalen	R. F. L. Crossman & D. Resta	Sunbeam, 80 × 149, 2,996 c.c.	11 52 3.2	75.83
1000 miles ,,	L. Coatalen	R. F. L. Crossman & D. Resta	Sunbeam, 80 × 149, 2,996 c.c.	13 8 25.1	76.10
				mls. yds.	
1 hour (standing start)	L. Coatalen	R. F. L. Crossman	Sunbeam, 80 × 149, 2,996 c.c.	79 1673	79.95
2 hours ,,	L. Coatalen	R. F. L. Crossman & D. Resta	Sunbeam, 80 × 149, 2,996 c.c.	158 994	79.28
3 hours ,,	R. Lisle	R. Lisle	Star, 90 × 150, 3,817 c.c.	239 266	79.72
4 hours ,,	L. Coatalen	R. F. L. Crossman & D. Resta	Sunbeam, 80 × 149, 2,996 c.c.	319 242	79.78
5 hours ,,	R. Lisle	R. Lisle	Star, 90 × 150, 3,817 c.c.	396 1752	79.40
6 hours ,,	R. Lisle	R. Lisle	Star, 90 × 150, 3,817 c.c.	470 649	78.39
7 hours ,,	R. Lisle	R. Lisle	Star, 90 × 150, 3,817 c.c.	552 439	78.89
8 hours ,,	R. Lisle	R. Lisle	Star, 90 × 150, 3,817 c.c.	627 1308	78.47
9 hours ,,	L. Coatalen	R. F. L. Crossman & D. Resta	Sunbeam, 80 × 149, 2,996 c.c.	667 1438	74.19
10 hours ,,	L. Coatalen	R. F. L. Crossman & D. Resta	Sunbeam, 80 × 149, 2,996 c.c.	751 1531	75.19
11 hours ,,	L. Coatalen	R. F. L. Crossman & D. Resta	Sunbeam, 80 × 149, 2,996 c.c.	827 942	75.23
12 hours ,,	L. Coatalen	R. F. L. Crossman & D. Resta	Sunbeam, 80 × 149, 2,996 c.c.	910 1738	75.92
13 hours ,,	L. Coatalen	R. F. L. Crossman & D. Resta	Sunbeam, 80 × 149, 2,996 c.c.	987 1548	75.99

F.—MAXIMUM CAPACITY, 305 CUBIC INCHES, OR 4,998 CUBIC CENTIMETRES.

Distance.	Holder.	Driver.	Car and Engine Size.	Time or Distance.	Speed. M.P.H.
½-mile (flying start)	Lord Shrewsbury	Percy Lambert	Talbot, 101.5 × 140, 4,531 c.c.	15.89	113.28
Kilometre (flying start)	Lord Shrewsbury	Percy Lambert	Talbot, 101.5 × 140, 4,531 c.c.	19.83	112.81
Mile (flying start)	Lord Shrewsbury	Percy Lambert	Talbot, 101.5 × 140, 4,531 c.c.	32.22	111.73
10 laps (standing start)	Lord Shrewsbury	Percy Lambert	Talbot, 101.5 × 140, 4,531 c.c.	15 3.01	110.31
50 miles (standing start)	Lord Shrewsbury	Percy Lambert	Talbot, 101.5 × 140, 4,531 c.c.	27 2.23	110.96
100 miles ,,	Lord Shrewsbury	Percy Lambert	Talbot, 101.5 × 140, 4,531 c.c.	57 49.38	103.76
150 miles ,,	L. Coatalen	J. Chassagne	Sunbeam, 80 × 150, 4,524 c.c.	1 32 27.81	97.34
200 miles ,,	L. Coatalen	J. Chassagne & D. Resta	Sunbeam, 80 × 150, 4,524 c.c.	2 5 6.28	95.92
300 miles ,,	L. Coatalen	J. Chassagne & D. Resta	Sunbeam, 80 × 150, 4,524 c.c.	3 7 45.46	95.87
400 miles ,,	L. Coatalen	J. Chassagne & D. Resta	Sunbeam, 80 × 150, 4,524 c.c.	4 12 15.08	95.14
500 miles ,,	L. Coatalen	J. Chassagne, D. Resta, and K. Lee Guinness	Sunbeam, 80 × 150, 4,524 c.c.	5 16 40.01	94.74
600 miles ,,	L. Coatalen	Ditto ditto	Sunbeam, 80 × 150, 4,524 c.c.	6 22 54.16	94.02
700 miles ,,	L. Coatalen	Ditto ditto	Sunbeam, 80 × 150, 4,524 c.c.	7 29 36.55	93.41
800 miles ,,	L. Coatalen	Ditto ditto	Sunbeam, 80 × 150, 4,524 c.c.	8 34 25.15	93.31
900 miles ,,	L. Coatalen	Ditto ditto	Sunbeam, 80 × 150, 4,524 c.c.	9 53 22.29	91.00
1000 miles ,,	L. Coatalen	Ditto ditto	Sunbeam, 80 × 150, 4,524 c.c.	11 6 38.87	90.00
50 kilometres ,,	Lord Shrewsbury	Percy Lambert	Talbot, 101.5 × 140, 4,531 c.c.	16 52.61	177.76*
				mls. yds.	
1 hour (standing start)	Lord Shrewsbury	Percy Lambert	Talbot, 101.5 × 140, 4,531 c.c.	103 1470	103.84
2 hours ,,	L. Coatalen	J. Chassagne	Sunbeam, 80 × 150, 4,524 c.c.	195 189	97.55
3 hours ,,	L. Coatalen	J. Chassagne & D. Resta	Sunbeam, 80 × 150, 4,524 c.c.	287 856	95.83
4 hours ,,	L. Coatalen	J. Chassagne & D. Resta	Sunbeam, 80 × 150, 4,524 c.c.	380 628	95.09
5 hours ,,	L. Coatalen	J. Chassagne, D. Resta, and K. Lee Guinness	Sunbeam, 80 × 150, 4,524 c.c.	473 464	94.65
6 hours ,,	L. Coatalen	Ditto ditto	Sunbeam, 80 × 150, 4,524 c.c.	566 589	94.39
7 hours ,,	L. Coatalen	Ditto ditto	Sunbeam, 80 × 150, 4,524 c.c.	653 147	93.29
8 hours ,,	L. Coatalen	Ditto ditto	Sunbeam, 80 × 150, 4,524 c.c.	748 247	93.51
9 hours ,,	L. Coatalen	Ditto ditto	Sunbeam, 80 × 150, 4,524 c.c.	840 1533	93.43
10 hours ,,	L. Coatalen	Ditto ditto	Sunbeam, 80 × 150, 4,524 c.c.	910 999	91.06
11 hours ,,	L. Coatalen	Ditto ditto	Sunbeam, 80 × 150, 4,524 c.c.	989 828	89.95
12 hours ,,	L. Coatalen	Ditto ditto	Sunbeam, 80 × 150, 4,524 c.c.	1078 460	89.85

G.—MAXIMUM CAPACITY, 475 CUBIC INCHES, OR 7,784 CUBIC CENTIMETRES.

Distance.	Holder.	Driver.	Car and Engine Size.	Time or Distance.	Speed. M.P.H.
½-mile (flying start)	H. Boissy	Jules Goux	Peugeot, 110 × 200, 7,602 c.c.	16.58	108.56
Kilometre (flying start)	H. Boissy	Jules Goux	Peugeot, 110 × 200, 7,602 c.c.	20.79	107.60
Mile (flying start)	H. Boissy	Jules Goux	Peugeot, 110 × 200, 7,602 c.c.	33.87	106.29
10 laps (standing start)	H. Boissy	Jules Goux	Peugeot, 110 × 200, 7,602 c.c.	15 40.75	105.88
50 miles (standing start)	H. Boissy	Jules Goux	Peugeot, 110 × 200, 7,602 c.c.	28 18.65	105.97
100 miles ,,	H. Boissy	Jules Goux	Peugeot, 110 × 200, 7,602 c.c.	56 29.93	106.20
150 miles ,,	H. Boissy	Jules Goux	Peugeot, 110 × 200, 7,602 c.c.	1 28 35.67	101.59
				mls. yds.	
1 hour (standing start)	H. Boissy	Jules Goux	Peugeot, 110 × 200, 7,602 c.c.	106 387	106.22

H.—MAXIMUM CAPACITY, 850 CUBIC INCHES, OR 13,929 CUBIC CENTIMETRES.

Distance.	Holder.	Driver.	Car and Engine Size.	Time or Distance.	Speed. M.P.H.
½-mile (flying start)	J. C. Christiaens	J. C. Christiaens	Excelsior, 110 × 160, 9,123 c.c.	16.62	108.30
Kilometre (flying start)	J. C. Christiaens	J. C. Christiaens	Excelsior, 110 × 160, 9,123 c.c.	20.62	108.48
Mile (flying start)	J. C. Christiaens	J. C. Christiaens	Excelsior, 110 × 160, 9,123 c.c.	33.69	106.86
10 laps (standing start)	L. Coatalen	Jean Chassagne	Sunbeam, 80 × 150, 9,048 c.c.	15 5.30	110.03
50 miles (standing start)	L. Coatalen	Jean Chassagne	Sunbeam, 80 × 150, 9,048 c.c.	27 40.87	108.38
100 miles ,,	L. Coatalen	Jean Chassagne	Sunbeam, 80 × 150, 9,048 c.c.	55 35.55	107.93
150 miles ,,	L. Coatalen	Jean Chassagne	Sunbeam, 80 × 150, 9,048 c.c.	1 25 14.94	105.57
				mls. yds.	
1 hour (standing start)	L. Coatalen	Jean Chassagne	Sunbeam, 80 × 150, 9,048 c.c.	107 1672	107.95

J.—CAPACITY OVER 850 CUBIC INCHES, OR OVER 13,929 CUBIC CENTIMETRES.

Distance.	Holder.	Driver.	Car and Engine Size.	Time or Distance.	Speed. M.P.H.
½-mile (flying start)	H. Arkwright	L. G. Hornsted	Benz, 185 × 200, 21,504 c.c.	14.53	123.88
Mile (flying start)	H. Arkwright	L. G. Hornsted	Benz, 185 × 200, 21,504 c.c.	29.14	123.54
2 miles (flying start)	H. Arkwright	L. G. Hornsted	Benz, 185 × 200, 21,504 c.c.	58.99	122.05
5 miles (flying start)	H. Arkwright	L. G. Hornsted	Benz, 185 × 200, 21,504 c.c.	2 35.08	116.08
10 miles (flying start)	H. Arkwright	L. G. Hornsted	Benz, 185 × 200, 21,504 c.c.	5 19.78	112.57
10 laps (standing start)	W. M. Letts	V. Hemery	Lorraine-Dietrich, 155 × 200, 15,095 c.c.	16 23.78	101.25
50 miles (standing start)	W. M. Letts	V. Hemery	Lorraine-Dietrich, 155 × 200, 15,095	29 31.46	101.61
100 miles ,,	W. M. Letts	V. Hemery	Lorraine-Dietrich, 155 × 200, 15,095	1 1 27.69	97.62
150 miles ,,	W. M. Letts	V. Hemery	Lorraine-Dietrich, 155 × 200, 15,095	1 31 52.06	97.97
200 miles ,,	W. M. Letts	V. Hemery	Lorraine-Dietrich, 155 × 200, 15,095	2 5 58.73	95.51
300 miles ,,	W. M. Letts	V. Hemery	Lorraine-Dietrich, 155 × 200, 15,095	3 32 57.08	84.57
400 miles ,,	W. M. Letts	V. Hemery	Lorraine-Dietrich, 155 × 200, 15,095	4 34 23.87	87.46
500 miles ,,	W. M. Letts	V. Hemery	Lorraine-Dietrich, 155 × 200, 15,095	5 48 38.87	86.05
				mls. yds.	
1 hour (standing start)	W. M. Letts	V. Hemery	Lorraine Dietrich, 155 × 200, 15,095	97 1037	97.59
2 hours ,,	W. M. Letts	V. Hemery	Lorraine-Dietrich, 155 × 200, 15,095	189 1747	94.99
3 hours ,,	W. M. Letts	V. Hemery	Lorraine-Dietrich, 155 × 200, 15,095	284 817	94.82
4 hours ,,	W. M. Letts	V. Hemery	Lorraine-Dietrich, 155 × 200, 15,095	344 1344	86.19
5 hours ,,	W. M. Letts	V. Hemery	Lorraine-Dietrich, 155 × 200, 15,095	422 1574	84.59
6 hours ,,	W. M. Letts	V. Hemery	Lorraine-Dietrich, 155 × 200, 15,095	518 312	86.36

* Kilometres per hour.

Brooklands R.A.C. Rating Classes.

Distance.	Holder.	Driver.	Car and Rating.	Time or Distance.	Speed, M.P.H.
		16 R.A.C. RATING CLASS.		h. m. s.	
¼-mile (flying start)	H. Boissy	Jules Goux	15.1 Peugeot	16.95	106.19
Kilometre (flying start)	H. Boissy	Jules Goux	15.1 Peugeot	21.14	105.81
Mile (flying start)	H. Boissy	Jules Goux	15.1 Peugeot	34.17	105.36
10 laps (standing start)	H. Boissy	Jules Goux	15.1 Peugeot	16 29.35	100.68
		21 R.A.C. RATING CLASS.			
¼-mile (flying start)	P. C. Kidner	A. J. Hancock	20.1 Vauxhall	17.78	101.24
Kilometre (flying start)	P. C. Kidner	A. J. Hancock	20.1 Vauxhall	22.06	101.403
Mile (flying start)	P. C. Kidner	A. J. Hancock	20.1 Vauxhall	36.14	99.61
10 laps (standing start)	P. C. Kidner	A. J. Hancock	20.1 Vauxhall	17 13.11	96.32
		26 R.A.C. RATING CLASS.			
¼-mile (flying start)	Earl of Shrewsbury and Talbot	Percy Lambert	25.5 Talbot	15.89	113.28
Kilometre (flying start)	Ditto ditto	Percy Lambert	25.5 Talbot	19.83	112.81
Mile (flying start)	Ditto ditto	Percy Lambert	25.5 Talbot	32.22	111.73
10 laps (standing start)	Ditto ditto	Percy Lambert	25.5 Talbot	15 3.01	110.31
		40 R.A.C. RATING CLASS.			
¼-mile (flying start)	H. Boissy	Jules Goux	30.0 Peugeot	16.58	108.56
Kilometre (flying start)	H. Boissy	Jules Goux	30.0 Peugeot	20.79	107.60
Mile (flying start)	H. Boissy	Jules Goux	30.0 Peugeot	33.87	106.29
10 lap (standing start)	H. Boissy	Jules Goux	30.0 Peugeot	15 40.75	105.88
		60 R.A.C. RATING CLASS.			
¼-mile (flying start)	G. Watney	M. Laurent	59.6 Mercédès	16.50	109.051
Kilometre (flying start)	J. C. Christiaens	J. C. Christiaens	45.0 Excelsior	20.62	108.48
Mile (flying start)	J. C. Christiaens	J. C. Christiaens	45.0 Excelsior	33.69	106.86
10 laps (standing start)	L. Coatalen	Jean Chassagne	47.6 Sunbeam	15 5.30	110.03
		90 R.A.C. RATING CLASS.			
¼-mile (flying start)	Cullum & Niven-Jack	V. Hemery	84.8 Benz	14.076	127.877
Kilometre (flying start)	Cullum & Niven-Jack	V. Hemery	84.8 Benz	17.761	125.947
Mile (flying start)	Cullum & Niven-Jack	V. Hemery	84.8 Benz	31.05	115.923
10 laps (standing start)	F. Newton	F. Newton	90.0 Napier	16 14.09	102.257

A limousine by Thrupp & Maberly on a Rolls-Royce chassis. Although the body is somewhat higher than usual, in order to give ample head room, it is not at all ungainly in appearanc

A Combined Fan and Lighting Dynamo.

THOSE who find it difficult to fit a lighting dynamo to their cars, owing to lack of space or other circumstances, will be interested in the Kemco fan-type dynamo, marketed by Morris, Russell and Co., Ltd., 6, Great Eastern Street, London, E.C.

As its name implies, the device is a dynamo and fan combined, and driven by the ordinary fan belt. It is a direct current generator having an output of 15 ampères at 6 volts or 8 ampères at 12 volts, and is capable of charging accumulators from which current is supplied for fulfilling all or any of the following duties: lighting five lamps, operating electric starter, changing gear, horn, and ignition.

The dynamo commences to charge the batteries at a speed of 400 to 600 r.p.m. and gives its rated output of 90 watts at 1,250 r.p.m. To prevent the battery discharging back through the dynamo when the engine is revolving slower than 400 to 600 r.p.m., or when it is stationary, a separate magnetic cut-out is provided. At high speeds the output is automatically controlled by means of magnetic leakage gaps and armature reaction, and the charging rate may also be regulated by adjusting the tension of the driving belt.

The whole device weighs under 11 lbs. The revolving portion, comprising the aluminium six-bladed fan, the fan casing and the ring wound armature running on ball bearings, weighs only two pounds. The field portion, which is the heaviest, remains stationary. The makers claim that the Kemco consumes only about one-tenth of a horse-power.

A Tabulated List of Gear Ratios.

A list of the gear ratios adopted on modern cars, showing the engine size, cubic capacity, gear ratio on each speed, number of speeds, and back wheel diameters.

All the cars which appear in the list have the direct drive on top speed with very few exceptions, which are referred to in the foot notes.

H.P., Name of Car, and Number of Cylinders.	Bore and Stroke.	Cubic Capacity.	Gear Ratios. 1st	2nd	3rd	4th	Rear Tyre Dia.
	mm.	c.c.					mm.
A.C. (1)	95 × 102	723	9	4.5	—	—	650
16-20 Adams (4)	88 × 120	2918	16.5	11.05	6.48	4	815
10 Adler (4)	65 × 98	1300	19	13	8	5	750
12 Adler (4)	75 × 103	1820	20	12.5	8	5	810
14-18 Adler (4)	75 × 120	2116	16	12	7	4.5	815
15-25 Adler (4)	80 × 130	2610	18	10.4	6.7	4.1	820
25-35 Adler (4)	92 × 148	3927	16	8.1	5.7	3.7	880
35-45 Adler (4)	114 × 160	6528	12	7	4.4	2.75	895
55-65 Adler (4)	125 × 160	7853	11.3	7	4.1	2.6	935
15 Albion (4)	79 × 127	2492	13.9	7	4.12	—	815
Alldays Midget (2)	85 × 88	998	11.7	7.8	4.5	—	650
10-12 Alldays (2)	95 × 115	1630	11.3	8.2	5.9	4.2	750
12-14 Alldays (4)	76 × 120	2174	13.2	7.5	5.4	3.84	760
16-20 Alldays (4)	86 × 130	3016	11.4	6.5	5.1	3.6	810
24-30 Alldays (4)	100 × 130	4082	13.3	9.2	5.3	3.6	810
30-50 Alldays (6)	95 × 115	4890	12.2	8.4	4.8	3.3	880
Arden (2), low	85 × 85	964	12.1	8.5	5	—	700
high	85 × 85	964	9	6	4.5	—	700
12-18 Argyll (4)	72 × 120	1953	16.2	9.15	6.24	4.16	760
15-30 Argyll (4), high	80 × 130	2610	16.2	9.15	6.24	4.16	815
low	80 × 130	2610	18.8	10.06	7.25	4.83	815
25-50 Argyll (4) high	100 × 130	4082	14.3	8.05	5.5	3.66	880
low	100 × 130	4082	16.9	9.53	6.5	4.33	880
Ariel (2)	85 × 85	964	16	5	—	—	650
12 Ariel (4), short	76 × 120	2174	13	7	4	—	760
12 Ariel (4) long	76 × 120	2174	13	7	4	—	810
15 Ariel (4)	80 × 130	2610	13	7	4	—	815
20 Ariel (4)	90 × 130	3307	11	7	4.5	3.5	820
25 Ariel (4)	100 × 130	4082	11	7	4.5	3.5	880
15-20 Armstrong-W. (4)	80 × 135	2710	16	9.5	5.8	3.8	815
17-25 Armstrong-W. (4)	85 × 135	3051	16	9.5	5.8	3.8	820
25-30 Armstrong-W. (4)	100 × 120	3768	12.5	9.2	5.9	3.8	880
30-50 A.-W. (6), worm	90 × 150	5724	12.5	9.2	5.9	3.8	895
bevel	90 × 150	5724	11.8	8	5.18	3.3	895
11.9 Arrol-Johnston (4)	69 × 120	1790	15	9.11	6.18	4	760
15.9 Arrol-Johnston (4)	80 × 140	2816	15	9.11	6.18	4	815
23.9 Arrol-Johnston (6)	80 × 120	3613	15	9.11	6.18	4	820
10 Austin (4)	76 × 89	1616	15	10	6.5	4.5	760
15 Austin (4)	89 × 115	2864	11	6	4.5	3.5	815
20 Austin (4)	89 × 126	3140	11	6	4.5	3.5	815
18-24 Austin (4)	111 × 127	4832	8.6	5.1	3.7	2.6	880
30 Austin (4)	111 × 152	5900	8.6	5.1	3.7	2.6	880
16-18 Aust.-Daimler (4)	80 × 110	2208	15.1	7.75	5.36	3.57	815
16-25 A.-D., Alpine (4)	80 × 110	2208	15.1	7.75	5.36	3.57	815
20-30 A.-D., Alpine (4)	90 × 140	3561	—	—	—	3.2	820
25-35 Aust.-Daimler (4)	105 × 130	4498	12	6	4	2.86	880
35-60 Aust.-Daimler (4)	120 × 154	6960	11.7	5.87	3.81	2.86	895
	120 × 154	6960	9.75	7.86	3.17	2.36	895
27-80 A.-D., P.H. (4)	105 × 165	5709	9.7	4.7	3.13	2.23	820
Autocrat (2)	85 × 85	964	10	6.5	3.5	-	650
Automobilette (1)	90 × 130	856	—	—	—	—	650
6-10 Automobilette (2)	70 × 130	1000	7.5	5.5	5	4	660
Autotrix (2)	70 × 80	723	10	7	4	—	700
Autotrix (2)	70 × 80	723	11.5	7.5	5	—	700
Autotrix (2)	85 × 85	964	11.5	7.5	5	—	700
8-10 Averies (4)	60 × 100	1128	10,5	7	4	—	650
15-20 Baguley (4), bevel	90 × 130	3307	12.7	7.35	5.8	3.56	815
worm	90 × 130	3307	13.4	7.78	6.15	3.78	815
8 Bayard (4)	60 × 120	1360	11.8	8.7	4	—	700
10 Bayard (4)	65 × 120	1592	11.8	8.7	4	—	750
11 Bayard (4)	75 × 110	1940	13.8	8.85	4.3	—	850
14 Bayard (4)	80 × 130	2610	13.55	7.55	5.5	4	810
18 Bayard (4)	85 × 140	3176	12.8	7	5.2	3.77	815
20 Bayard, Knight (4)	90 × 130	3307	13.55	7.55	5.5	4	815
20 Bayard (4)	100 × 140	4396	13.7	6.95	5.65	3.5	875
15 Bayard (6)	70 × 110	2534	12.95	7.17	4	—	760
20 Bayard (6)	80 × 120	3114	10.5	5.83	4.26	3.9	815
30 Bayard (6)	100 × 140	5594	7.45	5.2	4.55	2.62	875
10 Beacon (2)	85 × 110	1248	9	5	3.75	—	650
3½ Bedelia (1)	75 × 84	371	6	4		—	650
4½ Bedelia (1)	82 × 89	470	6	3.75		—	650
5½ Bedelia (1)	80 × 100	503	6	3.75		—	650
8-10 Bedelia (2)	80 × 100	1006	5.5	3.5	-	—	650
15-18 Bedford (4)	95 × 95	2693	14.5	6.5	4	—	810
18-22 Bedford (4)	102 × 102	3328	14.5	6.5	4	—	810
28-32 Bedford (4)	115 × 127	5279	14.5	6.5	4	—	880
16 Bell (4), high	91 × 120	3233	12.56	6.28	3.14	—	815
medium	91 × 120	3233	14.64	7.32	3.66	—	815
low	91 × 120	3233	16.48	8.24	4.12	—	815
20 Bell (4), high	102 × 140	4530	11.0	5.5	2.75	—	820
medium	102 × 140	4530	12.56	6.28	3.14	—	820
low	102 × 140	4530	14.64	7.32	3.66	—	820
30 Bell (4), high	115 × 150	6232	10.12	5.06	2.53	—	880
medium	115 × 150	6232	11.0	5.5	2.75	—	880
low	115 × 150	6232	12.56	6.28	3.14	—	880
10-12 Belsize (4), high	69 × 130	1944	15.86	7.35	4.57	—	800
low	69 × 130	1944	17.35	8.04	5	—	800
15.9 Belsize (4)	80 × 140	2816	11.22	6.27	5.02	3.57	815
14-16 Belsize (4)	93 × 120	3261	13	7.25	5.75	4.14	815
18-22 Belsize (6)	93 × 120	4891	10.8	6	4.8	3.44	820
16-20 Bentall (4)	100 × 95	2985	16.2	7.66	4.15	—	810
12-20 Benz (4)	72 × 120	1953	—	—	—	4.21	815
15-25 Benz (4), high	80 × 130	2610	—	—	—	3.87	820
low	80 × 130	2610	—	—	—	—	815
25-30 Benz (4)	90 × 140	3561	—	—	—	3.4	820
28-35 Benz (4)	95 × 140	3964	—	—	—	3.4	880
35-45 Benz (4)	120 × 144	6496	—	—	—	2.9	895
38-60 Benz (4)	125 × 150	7362	—	—	—	2.5	895
40-65 Benz (4)	130 × 160	8480	-	—	—	2.5	895
100 Benz (4)	130 × 190	10080	—		—	1.9	935
200 Benz (4)	185 × 200	22010	-	-	-	1.11	895
16-20 Benz-Sohne (4)	80 × 130	2610	10	8.4	6	3.8	820
16-20 Benz-Sohre (4)	85 × 115	2608	10	8.4	6	3.8	820
20-30 Benz-Sohne (4)	90 × 140	3561	8.75	7.1	5.1	3.24	820
12 Berliet (4)	70 × 100	1536	—	—	—	4.2	760
15 Berliet (4)	80 × 120	2409	—	—	—	3.85	815
18 Berliet (4)	90 × 140	3561	—	—	—	4.33	880
25 Berliet (4)	100 × 140	4396	—	—	—	3.66	880
30-40 Berliet (4)	120 × 140	6336	—	—	—	3	880
12-16 Bianchi (4)	75 × 120	2116		—	—	3.5	765
18 Bianchi (4)	90 × 115	2928			—	3.6	815
25-30 Bianchi (4)	100 × 140	4396	-		—	3	880
30-40 Bianchi (4)	110 × 150	5696	-		-	2.66	880
40-50 Bianchi (4)	130 × 160	8480	-		—	2.5	920
70 Bianchi (4)	130 × 150	7962				*	920
11 Brasier (4), high	67 × 110	1552	—	—	—	4.8	760
low	67 × 110	1552	—	-	—	5.2	760
12 Brasier (4), high	70 × 120	1843	—	—	—	3.68	765
low	70 × 120	1843	—	—	—	5.0	765
16 Brasier (4), high	85 × 140	3176	—	—	—	3.68	875
low	85 × 140	3176	—	—	—	5.0	875
22 Brasier (4), high	100 × 150	4704	—	—	—	3.0	880
low	100 × 150	4704	—	—	—	3.75	880
24 Brasier (6), high	90 × 140	5340	—	—	—	3.0	880
low	90 × 140	5340	—	—	—	3.75	880
10 Briton (4)	68 × 120	1744	11	5.5	3.5	—	760
14 Briton (4)	80 × 120	2412	11	5.5	3.5	—	810
†25-30 Brooke (6)	92 × 120	4788	9.45	4.89	3.19	2.75	880
†40 Brooke (6)	108 × 120	6576	9.45	4.89	3.19	2.75	880
B.S.A. (4)	75 × 114	2016	15.71	7.46	4.14	—	810
12-20 Buchet (4), high	76 × 120	2174	—	—	3.53	—	760
med'm	76 × 120	2174	—	—	3.73	—	760
low	76 × 120	2174	10.5	5.5	4	—	760
20-30 Cadillac (4)	114 × 145	5921	10.12	5.55	3.05	—	880
10½ Calcott (4)	65 × 110	1456	11	7	4	—	700
10-12 Calthorpe (4)	62 × 90	1088	11.8	6.85	4	—	700
12-15 Calthorpe (4)	69 × 125	1868	9.8	5.87	3.5	—	760
15 Calthorpe (4)	80 × 150	3012	9.7	6.8	4.8	3.4	810
20 Calthorpe (4)	90 × 150	3816	10.3	7.2	5.1	3.2	820
11-14 Chambers (4)	79 × 102	2000	13.0	7.5	4.02	—	760
12-16 Chambers (4)	86 × 102	2368	13.0	7.5	4.02	—	810
10 Charron (4)	65 × 120	1532	14.3	7.7	4.4	—	750
15 Charron (4)	80 × 120	2409	14.3	7.7	5.2	4	815
22 Charron (4)	95 × 130	3680	11	6.2	4.4	3.2	820
30 Charron (4)	110 × 150	5696	9	6.2	4.2	2.7	880
30 Charron (6)	95 × 130	5520	9	6.2	4.2	2.7	880
5-6 C. & H. (2)	70 × 80	723	10.5	7	4.5	-	700
8 C. & H. (2)	85 × 85	964	10.5	7	4.5	—	700
Chater-Lea (2)	85 × 85	964	10.5	6.75	4.13	—	650
10-14 Chenard-W. (4)	69 × 130	1944	11.5	7.5	5	4	760
12-18 Chenard-W. (4)	75 × 150	2646	12	7.25	5	3.75	810
16-20 Chenard-W. (4)	80 × 150	3012	10.5	7	4.5	3.5	815
24-30 Chenard-W. (6)	80 × 150	4518	10.5	7	4.56	3.5	880

* To order. † Direct on third gear.

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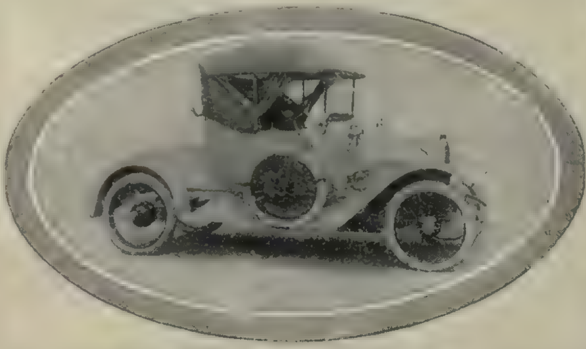

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A Tabulated List of Gear Ratios (*Continued*).

H.P., Name of Car, and Number of Cylinders.	Bore and Stroke.	Cubic Capacity.	Gear Ratios. 1st	2nd	3rd	4th	Rear Tyre Dia.
	mm.	c.c.					mm.
15.9 Cheswold (4)	80 × 130	2610	21	10.9	6.8	4.16	815
Chota (1)	89 × 120	746	8.2	4	—	—	660
C.L.C. (1)	80 × 140	704	20	14	9	4.75	700
12-14 Clement (4)	75 × 110	1940	14.4	8.4	5.6	4	760
14-18 Clement (4)	90 × 120	3053	13.2	7.73	5.15	3.73	815
25-35 Clement (4)	107 × 130	4680	—	—	—	3.5	880
35-45 Clement (4)	115 × 140	5818	—	—	—	2.61	880
20 Coltman (4)..........	101 × 114	3652	9.9	6.5	5.1	3	810
16-20 C'n.-Desgouttes (4)	80 × 160	3212	12.7	8	6.2	3.45	815
20-30 C'n.-Desgouttes (4)	100 × 160	5024	11.9	7.55	5.8	3.25	880
40 Cottin-Desgouttes (4)	120 × 160	7232	8.7	5.5	3.55	2.47	880
60 Cottin-Desgouttes (4)	130 × 200	10624	7.55	4.8	3.10	1.95	880
†Crescent (2)	85 × 85	964	12	9.5	7.5	5	650
10-12 Crespelle (4)......	65 × 130	1728	16	12	8	4	710
12-16 Crespelle (4)......	75 × 120	2116	15	11	7.5	4	760
14-18 Crespelle (4)......	75 × 150	2646	15	11	7	3.75	760
15 Crossley (4), high ...	79 × 120	2352	15	8	6	4	810
low ...	79 × 120	2352	16	9	7	4.26	815
20 Crossley (4), high ...	102 × 140	4576	15	8	6	3.4	880
low ...	102 × 140	4576	16	9	7	3.75	895
Crouch carette (2), ...	80 × 90	994	14	8	4.5	—	650
15 Daimler (4), high ...	80 × 130	2610	15.6	6.9	4.1	—	870
medium	80 × 130	2610	16.7	7.2	4.4	—	870
low ...	80 × 130	2610	17.9	7.8	4.8	—	870
20 Daimler (4), high ...	90 × 130	3307	14.7	8.1	5.5	3.8	875
medium	90 × 130	3307	15.8	8.7	5.9	4.1	875
low ...	90 × 130	3307	17.0	9.4	6.3	4.4	875
26 Daimler (4), high ...	102 × 140	4576	10.9	7.4	4.7	3.5	920
medium	102 × 140	4576	11.6	7.8	5.1	3.8	920
low ...	102 × 140	4576	12.7	8.5	5.5	4.1	920
38 Daimler (4), high ...	124 × 130	6272	9.5	6.4	4.1	3.1	920
medium	124 × 130	6272	10.1	6.8	4.4	3.3	920
low ...	124 × 130	6272	10.9	7.4	4.7	3.5	920
30 Daimler (6), high ...	90 × 130	4960	11.6	7.8	5.1	3.8	920
medium	90 × 130	4960	12.7	8.5	5.5	4.1	920
low ...	90 × 130	4960	13.5	9.0	5.8	4.4	920
Daimler, Special (6), high	102 × 140	6864	10.1	6.8	4.4	3.3	935
med.	102 × 140	6864	10.9	7.4	4.7	3.5	935
low	102 × 140	6864	11.6	7.8	5.1	3.8	935
12 Darracq (4)	75 × 120	2116	13.6	[illegible]	6.6	3.8	760
16 Darracq (4)	85 × 130	2938	12.5	9	5.6	3.7	815
Day-Leeds (2)	85 × 88	998	10	6.5	4	—	650
7 De Dion Bouton (2)	66 × 120	820	6.80	7.90	4.84	—	700
12 De Dion B. (4), low	66 × 120	1640	15.29	8.09	4.85	—	810
high	66 × 120	1640	14.27	7.55	4.53	—	810
14 De Dion B (4), low	75 × 130	2298	26.40	10.3	7.26	4.40	815
high	75 × 130	2298	24	9.68	6.60	4	815
18 De Dion B. (4), low	80 × 140	2816	29.22	11.68	7.53	4.40	875
high	80 × 140	2816	26.56	10.60	6.84	4	875
25 De Dion B. (4), low	100 × 140	4396	25.05	9.54	5.72	3.33	880
high	100 × 140	4396	23.51	8.95	5.37	3.12	880
†25 De Dion Bouton (4)	100 × 140	4396	27.84	10.60	6.36	3.70	880
26 De Dion Bouton (8)	75 × 130	4596	24.66	9.86	6.36	3.71	880
†26 De Dion Bouton (8)	75 × 130	4596	24.63	9.85	6.35	3.71	880
†50 De Dion Bouton (8)	94 × 140	7766	19.12	8.29	4.98	2.90	935
8-10 Delahaye (2)	80 × 120	1205	20	8.75	5	—	760
9-11 Delahaye (4)	62 × 100	1208	17	10	6	4.5	760
12-16 Delahaye (4)	75 × 110	1940	15.5	8	5	4	815
16-20 Delahaye (4)	85 × 130	2938	15.8	8	4.8	3.3	880
20-30 Delahaye (4)	95 × 130	3680	20	8.75	5	—	880
18-24 Delahaye (6)	75 × 120	3174	15.5	8	5	4	880
17 Delaunay-Belleville (4)	85 × 130	2938	14.47	9.26	5.86	3.86	875
25 Delaunay-Belleville (4)	100 × 140	4396	13.65	8.63	5.53	3.64	880
26 Delaunay-Belleville (6)	85 × 130	4407	13.65	8.63	5.53	3.64	880
37 Delaunay-Belleville (6)	100 × 140	6594	11.77	7.93	4.77	3.14	920
20 Dennis (4)	90 × 130	3307	12	8.1	5.2	3.55	815
24 Dennis (4)	100 × 130	4082	12	8.1	5.2	3.55	880
10-12 D.F.P. (4)	65 × 120	1592	13.24	7.37	4.23	—	750
12-15 D.F.P. (4)	70 × 130	1996	13.72	7.62	6.25	3.92	760
16-22 D.F.P. (4)	80 × 150	3012	11.12	6.54	5.20	3.6	815
12-16 Dodson (4)	80 × 120	2409	16.5	10.5	6.9	4.5	810
20-30 Dodson (4)	100 × 140	4396	11	7	4.6	3	880
†Duocar (2)...........	70 × 80	616	9	5	—	—	650
†Duocar (2)...........	85 × 85	964	9	4	—	—	650
8-10 Eagle (2)	85 × 88	998	11.00	7.25	4.7	—	650
12 Enfield (4)	76 × 120	2174	13	7.5	5.4	3.84	810
	76 × 120	2174	13	7.	5.4	3.84	815
16 Enfield (4)	86 × 130	3016	11.4	6.5	5.1	3.6	815
25 Enfield (4)	100 × 130	4082	13	9	5.2	3.5	815
Everitt	102 × 120	3914	—	—	3.5	—	915
14-20 Excelsior (4)	85 × 130	2938	9	4.8	3.3	-	815
20-30 Excelsior (6)	85 × 130	4407	8	4.2	3	—	815

H.P., Name of Car, and Number of Cylinders.	Bore and Stroke.	Cubic Capacity.	Gear Ratios. 1st	2nd	3rd	4th	Rear Tyre Dia.
	mm.	c.c.					
F.A.B. (4)	75 × 120	2116	8.2	4	3.46	1.9	815
F.A.B. (4)	90 × 140	3561	9.2	4.56	3.9	2.14	815
12-14 F.I.A.T. (4)	70 × 120	1843	17.64	11.76	7.58	4.92	810
15-20 F.I.A.T. (4)	80 × 110	2816	14.6	9.74	6.27	4.07	815
20-30 F.I.A.T. (4)	100 × 140	4396	12.63	8.12	5.47	3.5	880
35-50 F.I.A.T. (4)	110 × 150	5696	11.06	7.11	4.79	3.06	880
15-9 F.L. (4)	80 × 100	2012	13	8	5	4	815
18-24 F.L. (6)	80 × 100	3018	10	8	5	3	820
18 Florio (4)	85 × 130	2938	18	9	6	4	815
8-10 Flycar (2)	85 × 96	1017	9	6	4	—	650
12-14 F.N. (4)	69 × 130	1944	17.94	11.02	7.4	4.73	815
18 F.N. (4)	85 × 120	2712	16.37	9.72	6.14	3.93	820
20 Ford (4)	95 × 102	2892	10	3.63	—	—	760
Forest (2), friction dr.	84 × 120	1328	14	3.5	—	—	700
10-12 Georges-Richard (4)	65 × 110	1456	15.5	10.33	6	4.5	760
15.9 Germain (4), high .	80 × 140	2816	—	—	—	3.75	820
low ..	80 × 140	2816	—	—	—	4.28	820
20 Germain (4), high ..	90 × 130	3307	—	—	—	3.16	820
medium	90 × 130	3307	—	—	—	3.3	880
low	90 × 130	3307	—	—	—	3.56	820
worm ..	90 × 130	3307	—	—	—	3.77	880
18-22 Germain (4), high .	102 × 110	3584	—	—	—	3.28	815
medium	102 × 110	3584	—	—	—	3.56	815
low .	102 × 110	3584	—	—	—	4.07	815
28-35 Germain (4), high	120 × 130	5876	—	—	—	3.16	880
low .	120 × 130	5876	—	—	—	3.56	880
Gillyard (2)	85 × 85	964	11	7.5	4	—	650
12.1 Gladiator (4), high .	70 × 110	1689	11.8	4.28	3.57	—	760
medium	70 × 110	1689	12	5.36	3.87	—	760
low .	70 × 110	1689	13.2	5.74	4.16	—	760
15.9 Gladiator (4), high .	80 × 130	2610	10.73	5.88	3.7	—	815
low .	80 × 130	2610	12.3	6.37	4.0	—	815
4-sp. mod., high	80 × 130	2610	14.8	9.13	5.48	3.7	815
low	80 × 130	2610	16.2	9.92	6.56	4.0	875
30-35 Gladiator (4) high	101 × 130	4165	14.31	8.22	4.24	3.29	[illegible]
low	101 × 130	4165	15.26	8.85	5.6	3.5	820
8 Globe (1)	105 × 120	1037	8	4	—	—	700
4½ Glover (1)	89 × 96	597	8.2	4	—	—	650
8 Gordon (2)	85 × 95	1074	11.5	7.5	4.5	—	650
10 Gordon (2)	85 × 120	1360	12	8	5	—	700
†12 Grégoire, Dumont (1)	100 × 170	1336	15.8	5.5	—	—	750
10-14 Grégoire (4)	65 × 130	1728	20	12.04	8.06	5.4	810
14-16 Grégoire (4)	80 × 110	2208	11.6	8.47	5.81	4	810
15 Grégoire, Knight (4)	80 × 130	2610	12.04	8.07	6.02	4.1	815
16-24 Grégoire (4)	80 × 160	3212	11.6	8.47	5.81	[illegible]	875
8 G.W.K. (2)	86 × 92	1068	9	6.2	4.7	3.9	650
10 Hillman (2)	90 × 140	1780	13.5	7.8	4.6	—	700
9 Hillman (4)	60 × 120	1357	13.12	7.63	4.5	—	700
12-15 Hillman (4)	89 × 110	2736	11.8	6.8	4.06	-	760
25 Hillman (4)	127 × 127	6436	7.8	3.9	2.5	—	820
12-20 Hispano-Suiza (4)	80 × 110	2208	12.5	6.6	4.3	—	810
15-30 Hispano-Suiza (4)	80 × 130	2610	10.8	5.8	3.6	—	815
30-40 Hispano-Suiza (4)	100 × 150	4704	9.6	5	3.8	3.2	880
45 Hispano-Suiza (4) ...	80 × 180	3616	8.7	5	2.9	—	815
15 H.L. (4)	76 × 120	2174	8	4	—	—	760
Hotchkiss (4)	80 × 120	2409	17.1	9.5	6.3	4.2	815
Hotchkiss (4)	95 × 130	3680	14	7.7	5.1	3.4	880
Hotchkiss (4)	110 × 150	5696	12.1	6.7	4.5	[illegible]	895
Hotchkiss (6)	95 × 130	5522	12.1	6.7	4.5	3	895
8 Humberette (2)	84 × 90	1000	13.6	7.8	4.46	—	650
11 Humber (4), high ...	69 × 130	1944	14.6	9	5.8	4.06	810
low ...	69 × 130	1944	15.5	9.6	6.2	4.3	810
14 Humber (4), high ...	75 × 130	2298	13.75	8.47	5.45	3.82	815
low ...	75 × 130	2298	14.6	9	5.8	4.06	815
20 Humber (4), high ...	90 × 120	3052	13.85	8.95	6.12	3.87	820
low ...	90 × 120	3052	14.8	9.5	6.55	4.14	820
28 Humber (4), high ...	105 × 140	4844	12.02	6.5	4.04	3	820
low	105 × 140	4844	—	—	—	2.7	820
12-14 Hupmobile (4), high	83 × 88	1904	10.8	4	—	—	760
low	83 × 88	1904	12.9	4.8	—	—	760
15-18 Hupmobile (4)	83 × 140	3032	13	6.5	3.6	—	800
10 Hurtu (4)	70 × 110	1689	14	7	4	—	700
14 Hurtu (4)	75 × 120	2116	14	7	3.75	—	760
8-10 Imperia (4)	75 × 100	1764	13	7.5	4	—	—
10-12 Imperia (4)	70 × 120	1843	17	8.5	5.8	4.25	760
14-16 Imperia (4)	80 × 130	2610	14.5	7.9	5.7	4.14	815
18-24 Imperia (4)	90 × 140	3561	12.8	7	5.1	3.66	820
23-35 Imperia (4) .. .	100 × 160	5024	11.3	6.2	4.5	3.23	880
Invicta (2)..........	85 × 85	964	15.5	7.5	5	—	—

†Crescent has friction drive: fifth gear. 3.25 to 1. †These De Dions are worm-driven. †Duocar has belt drive with expanding pulleys.
†Grégoire Dumont has friction drive giving nine speeds

A Tabulated List of Gear Ratios (*Continued*).

H.P., Name of Car, and Number of Cylinders.	Bore and Stroke.	Cubic Capacity.	Gear Ratios. 1st	2nd	3rd	4th	Rear Tyre Dia.
	mm.	c.c.					
15 Iris (4)	80 × 114	2288	13.9	7.28	4.07	--	815
15 Iris (4) Colonial	80 × 114	2288	15.0	7.85	4.38	–	875
25 Iris (4)	108 × 133	4870	9.7	5.32	2.92	--	880
35 Iris (4)	127 × 133	6735	8.2	4.44	2.46	—	880
12-15 Isotta-Fraschini (4)	75 × 130	2298	–	—	—	4.4	810
16-20 Isotta-Fraschini (4)							
short	85 × 130	2938	—	–	—	4	815
long	85 × 130	2938	—	—	—	4	820
20-25 Isotta-Fraschini (4)	100 × 140	4396	—	—	—	3.7	880
30-35 Isotta-Fraschini (4)	110 × 160	6080	–	—	—	3.7	880
	110 × 160	6080	—	–	-	3.7	895
27-80 Isotta-Fraschini (4)							
short	105 × 180	6236	—		–	—	920
100 Isotta-Fraschini (4)	130 × 200	10624	-	—	—	1.75	920
normal	130 × 200	10624	—	–	—	1.75	935
14-20 Itala (4)	77 × 120	2232	13.8	10.8	5.9	3.9	815
18-30 Itala (4)	90 × 130	3307	12.4	9.74	5.3	3.5	815
25-35 Itala (4)	115 × 130	5408	9.75	5.73	4.0	2.78	880
35-45 Itala (4)	127 × 140	7089	7.92	4.91	3.7	2.38	895
50-65 Itala (4)	140 × 150	9248	7.1	4.4	3.08	2.13	895
60-70 Itala (4)	127 × 160	8096	7.92	4.91	3.70	2.38	895
*120 Itala (4)	155 × 160	12070	—	—	—	—	895
*25 Itala (4), rotary	90 × 130	3307	14.7	11.45	6.75	4.12	820
*35 Itala (4), rotary	105 × 150	5190	10.75	6.68	4.67	3.22	880
*60 Itala (6)	130 × 140	11136	—	—	—	—	895
*75 Itala (6)	140 × 140	12912	—	—	—	—	895
10-14 Jackson (2)	85 × 120	1356	--	3.5	—	—	750
13-16 Jackson (4)	75 × 120	2116	—	--	3.5	—	810
Kendall (2)	80 × 94	944	[illegible]	4	—	—	650
Kendall (2)	84 × 94	1040	10.5	4	—	—	650
11 Lagonda (4)	67 × 78	1100	10	6	3.5	–	700
20 Lagonda (4)	90 × 120	3052	10	6.2	4	—	810
30 Lagonda (6)	90 × 120	4578	9.5	5.5	3.5	—	875
25 Lanchester (4)	101 × 101	3137	13	6.5	3.8	—	880
	101 × 101	3137	15	7.5	4.37	—	1020
38 Lancuester (6)	101 × 101	4856	11	5.5	3.3	—	935
	101 × 101	4856	13	6.5	3.8	—	1020
30 Lancia (4)	100 × 130	4082	12.2	7.9	5.4	3.2	820
14-20 Leon-Bollée (4)	83 × 110	2368	15	9	6.5	4	810
20-30 Leon-Bollée (6)	83 × 110	3552	13.5	7.7	5.5	3.5	820
10.5 Licorne (4)	65 × 130	1728	—	—	4	—	800
13.9 Licorne (4)	75 × 120	2116	—	—	—	4	810
13.9 Licorne (4)	75 × 150	2646	—	—	—	4	815
14 Licorne, Mod. BX3	75 × 120	2116	12	8	4	—	—
Mod. BX4	75 × 120	2116	12	8	6	4	—
18 Licorne, Mod. HX4	75 × 150	2646	12	8	6	4	—
8 L.M. (2)	85 × 85	964	10.25	4.88	—	—	650
12-14 Loreley (4)	70 × 102	1568	—	—	5	—	760
15 Loreley (4)	76 × 115	2052	–	–	4	–	810
12-14 Loreley (6)	60 × 92	1560	—	—	5	–	760
18-22 Loreley (6)	70 × 113	2610	---	—	4	—	815
10-12 M.A.F. (4)	68 × 90	1308	15.4	8.2	4.8	—	750
12-14 M.A.F. (4)	72 × 96	1564	12.8	6.8	4	—	760
	72 × 96	1564	15.4	8.2	4.8	—	760
20-25 Marathon (4)	89 × 114	2836	10	6	4	—	810
30-35 Marathon (4)	108 × 114	4160	11	6	4	—	875
8-10 Marlborough (4)	59 × 100	1092	13	8	4	—	700
12-18 Martini (4)	80 × 120	2409		--	—	5.33	810
Martini (4)	80 × 130	2610	-	—	—	3.56	815
16-24 Martini (4)	90 × 140	3561	—	—	—	4.43	815
	90 × 140	3561	--	—	--	4.43	880
25-35 Martini, Knight (4)	100 × 140	4396	—	—	—	2.84	880
10 Mass (4)	75 × 100	1764	10	6	3.5	—	750
12 Mass (4)	75 × 140	2472	9	5.5	3	—	810
15 Mass (4)	90 × 150	3816	9	5.5	3	—	815
20 Mass (4)	110 × 130	4940	[illegible]	5.5	[illegible]	—	880
25 Mass (6)	80 × 180	5424	9	5.5	3	—	820
17 Maudslay (4)	90 × 130	3307	16.6	7.6	4.85	3.5	820
27 Maudslay (6)	90 × 130	4960	14.9	6.85	4.36	3.15	880
Maxwell, Messenger (4)	95 × 102	2892	12.5	5.5	3.5	—	760
Maxwell, Mascotte (4)	102 × 102	3328	12.5	5.5	3.5	—	810
12-15 Mercédès (4)	70 × 120	1843	20	11.6	7	4.8	815
15-20 Mercédès (4)	80 × 130	2610	17.3	10.1	5.8	4.06	820
25-30 Mercédès (4)	90 × 140	3561	14.3	7.5	4.8	3.3	820
35-40 Mercédès, S.K. (4)	100 × 130	4082	12.8	6.7	4.3	3	820
35-40 Mer., Poppet (4)	110 × 150	5696	11.4	6.3	4	3	895
*35-40 Mer., Colonial (4)	110 × 150	5696	—	—	—	—	1020
45-50 Mercédès (4)	120 × 160	7232	9.1	5	3.2	2.4	915
*45-50 Mercédès (4)	120 × 160	7232	12.6	7	5.2	3.3	935
*65-70 Mercédès (4)	140 × 160	9856	—	—	—	—	935
*80-90 Mercédès (4)	130 × 180	9568	—	—	—	—	935
10-12 Métallurgique (4)	75 × 96	1696	16.94	10.89	6.05	4.84	760
15-20 Métallurgique (4)	80 × 130	2610	16.03	10.30	5.73	4.58	815
	80 × 130	2610	14.80	9.52	5.29	4.23	815
20-30 Métallurgique (4)	90 × 140	3561	13.72	8.82	4.90	3.92	820

H.P., Name of Car, and Number of Cylinders.	Bore and Stroke	Cubic Capacity.	Gear Ratios. 1st	2nd	3rd	4th	Rear Tyre Dia.
	mm.	c.c.					mm.
20-30 Metallurgique (4)	90 × 140	3561	12.81	8.24	4.58	3.66	820
20-40 Métallurgique (4)	90 × 140	3561	12	7.72	4.29	3.43	820
26-50 Métallurgique (4)	102 × 150	4896	11.80	7.58	4.21	3.37	880
	102 × 150	4896	11.09	7.13	3.96	3.17	880
26-60 Métallurgique (4)	102 × 150	4896	10.67	6.86	3.81	3.05	880
38-80 Métallurgique (4)	125 × 150	7362	9.45	6.08	3.38	2.7	895
38-90 Métallurgique (4)	125 × 150	7362	8.54	5.49	3.05	2.44	895
*Metz Lion (4)	95 × 102	2892	14.1	9.1	5.1	3	810
14 Minerva (4)	75 × 120	2116	-	-	-	4.5	815
18 Minerva (4)	90 × 130	3307	–			3.75	815
26 Minerva (4)	100 × 140	4396	-	–		3.25	880
38 Minerva (4)	124 × 150	7232	—	—	-	2.5	880
8 Morgan (2)	85 × 85	964	8	4.25	—	—	650
10 Morris Oxford (4)	60 × 90	1016	14.3	7.15	4.2	—	700
12 Motobloc (4)	80 × 120	2409	17.2	8.7	6.8	4.5	815
16 Motobloc (4)	90 × 130	3307	13.4	6.8	5.2	3.5	810
N.A.G., Mod. K2 (4)	75 × 85	1500	22.8	10.14	4.92	—	760
N.A.G., Mod. K3 (4)	75 × 118	2080	23.35	11.11	6.49	4.24	815
N.A.G., Mod. K4 (4)	83 × 120	2600	19.28	10.28	6.68	4.28	820
N.A.G., Mod. K5 (4)	90 × 130	3307	12.1	9.12	5.82	3.8	820
N.A.G., Mod. K6 (4)	115 × 125	5194	14.61	7.8	5.06	3.25	880
N.A.G., Mod. K8 (4)	130 × 160	8480	11.7	6.24	4.06	2.6	895
15 Napier (4), bevel	82 × 127	2684	16.8	7.25	4	—	815
	82 × 127	2684	20	8.65	4.77	-	915
worm	82 × 127	2684	16.8	7.25	4	-	815
	82 × 127	2684	16.8	8.75	[illegible]	4	815
30 Napier (6), worm	82 × 127	4026	15.2	9.1	4.14	-	895
45 Napier (6), bevel	102 × 127	6840	10.4	4.85	3.07	-	895
59.9 Napier (6), bevel	127 × 127	9655	6.5	3.88	2.45	—	895
20-30 Nazzaro (4)	100 × 140	4396	12.9	7.9	5	3.6	880
11.9 N.B. (4), high	69 × 140	2096	15	10	7.5	3.6	810
low	69 × 140	2096	15	10	7.5	4	810
30 N.E.C. (4)	114 × 114	4640	15.5	7.9	5.06	3.87	920
40 N.E.C. (4)	127 × 114	5776	15.5	7.9	5.06	3.87	920
20 New Pick (4)	90 × 127	3232	10	6	3	-	800
10-12 N.S.U. (4) high	70 × 80	1232	—	—	5	—	700
low	70 × 80	1232	—	—	5.45	—	700
14 N.S.U. (4) high	75 × 88	1556	—	—	5.08	—	760
low	75 × 88	1556	—	—	5.54	—	760
18 N.S.U. (4) high	80 × 104	2088	—	—	—	4.35	815
medium	80 × 104	2088	—	—	—	4.69	815
medium	80 × 104	2088	—	—	—	5.08	815
low	80 × 104	2088	—	—	—	5.54	815
20 N.S.U. (4) high	85 × 115	2608	—	—	—	3.73	815
low	85 × 115	2608	—	—	—	4.3	815
24 N.S.U. (4) high	97 × 115	3400	—	—	—	3	820
medium	97 × 115	3400	—	—	—	[illegible]	820
low	97 × 115	3400	—	—	—	4.28	820
15-20 Oakland (4)	88 × 127	3098	—	—	4	—	810
26 Oakland (4)	105 × 120	4158	—	—	4	—	875
40 Oakland (6)	105 × 120	6237	—	—	3.5	—	880
5-12 Opel (4)	65 × 98	1300	19	9.5	6.75	4.75	700
6-16 Opel (4)	70 × 100	1540	19	9.5	6.75	4.75	760
8-20 Opel (4)	75 × 115	2032	19.6	9.85	7.05	4.9	810
8-30 Opel (4)	70 × 135	2080	15	7.5	5.35	3.76	765
10-25 Opel (4)	84 × 118	2616	20	9.72	6.5	4.25	815
14-30 Opel (4)	90 × 130	3307	18.6	9.15	6.1	4	815
18-40 Opel (4)	105 × 135	4676	15.9	8.3	5.12	3.4	880
24-50 Opel (4)	115 × 150	6228	10.	5.68	4.1	2.9	895
25-55 Opel (4)	120 × 144	6510	11.8	6.92	4.45	2.95	895
34-65 Opel (4)	130 × 165	8800	8.35	4.73	3.4	2.4	895
40-100 Opel (4)	140 × 165	10200	7.72	4.36	3.14	2.23	895
20-25 Overland (4)	102 × 114	3712	9	5.5	3.5	-	810
25-30 Overland (4)	111 × 114	4413	9	5.5	3.5	—	875
10-18 Palladium (4)	65 × 130	1728	12	7.5	4.25	—	700
12-22 Palladium (4)	75 × 130	2298	11.5	5.5	3.73	—	760
15-26 Palladium (4)	75 × 150	2646	11.5	5.5	3.73	—	810
18-30 Palladium (4)	96 × 135	5894	11.7	5.5	3.5	—	820
12 Panhard (4)	70 × 140	2150	16.6	9.3	6.4	4	760
15 Panhard (4), low	80 × 120	2409	17.5	9.5	6.9	5	815
high	80 × 120	2409	15.8	8.6	6.2	4.5	815
25 Panhard, S.K. (4)	100 × 140	4396	11.6	6.4	4.5	3.4	880
27.5 Pathfinder	105 × 133	4608	—	—	3	—	875
	105 × 133	4608	—	—	3.7	—	875
	105 × 133	4608	—	—	4	—	875
8 P.D.A. (2)	85 × 85	964	9.7	4.7	—	—	650
Perry (2)	72 × 108	879	13.25	8.1	4.9	—	700
8 Pearson-Cox (2)	85 × 85	964	12	5	—	—	650
Phanomobile, V (2)	82 × 84	888	10	5	-	—	650
Phanomobile (2)	82 × 101	1160	13	5.25	—	—	700
Phanomobile (4)	74 × 90	1548	13	5.25	—	—	710

*The three largest Itala models—120 h.p. 4 cyls., 60 h.p. and 75 h.p. 6 cyls.—are geared to requirements; the engines of the rotary valve Italas run at higher normal speeds than the poppet types. *These Mercédès are chain-driven. *The Metz Lion has friction drive.

A Tabulated List of Gear Ratios (*Continued*).

H.P., Name of Car, and Number of Cylinders.	Bore and Stroke.	Cubic Capacity.	Gear Ratios. 1st	2nd	3rd	4th	Rear Tyre Dia.
	mm.	c.c.					mm.
Phanophone (2)	80 × 108	1086	10	6	3.5	—	700
8-10 Phœnix (2)	90 × 100	1272	12.5	7.5	4.25	—	700
12.9 Phœnix (2)	102 × 115	1872	12.5	7.5	4.25	-	750
11 9 Phœnix (4)	69 × 100	1496	16.5	7	4.14	-	750
Pilgrim (2), high	98 × 102	1519	16.1	8	4.18	-	810
low	98 × 102	1519	17.28	8.34	4.46	-	810
*Pilot (4)	65 × 110	1456	12	10	8	6.39	700
9 Premier	85 × 88	998	9	4.5	—	-	—
12-16 R.C.H. (4)	83 × 127	2744	10	5.5	3.64	—	810
15.9 R.C.H. (4)	80 × 127	2550	13.8	8.5	4.25	-	840
10 Riley, V engine (2)	96 × 96	1390	13.92	9.28	4.64		800
12-18 Riley V, en. (2), h.	102 × 127	2058	12.18	8.12	4.06	—	810
low	102 × 127	2058	12.99	8.66	4.33	-	810
18-20 R.M.C. (4)	95 × 114	3232	10.67	6	4	—	810
	95 × 114	3232	9.78	5.54	3.68	—	810
	95 × 114	3232	8.54	5.32	3.2	—	810
40-50 Rolls-Royce (6)	114 × 121	7411	8.47	5.1	3.06	—	895
15 Rothwell (4), high	79 × 127	2490	11.3	5.19	2.95	—	815
medium	79 × 127	2490	13.6	6.3	3.6	—	815
low	79 × 127	2490	17.21	7.97	4.53		815
20 Rothwell (4), high	102 × 127	4227	11.3	5.19	2.95		815
medium	102 × 127	4227	13.6	6.3	3.6		815
low	102 × 127	4227	17.21	7.97	4.53		815
Ranger (2)	85 × 85	[illegible]	9.5	4.5	--	-	650
*Rollo (2)	85 × 85	964	7.5	4.25	—	—	650
12 Rover (4)	75 × 130	2298	17.7	8.4	4.4		810
18 Rover (4)	90 × 130	3307	16	8.3	5.34	-	820
8 Sabella (2)	85 × 85	964	—	—	—	—	—
10 Sabella (2)	85 × 95	1078	10	4	-	-	—
8 Salmon (4)	57 × 76	776	18	6	--	—	650
9-11 Salmon (4)	69 × 90	1344	15.1	9	5	—	750
14-18 Sava (4)	75 × 140	2472	13.2	8.6	6.1	4.4	815
18-26 Sava (4), low	82 × 110	2960	11.5	7.5	5.1	3.5	820
high	82 × 110	2960	11	7	4.6	3	820
26 32 Sava (4)	100 × 160	5024	11	7	4.6	3	880
S.C.A.R. (4), high	80 × 140	2816	14	9	5.5	3.33	815
medium	80 × 140	2816	14	9	6	3.75	815
low	80 × 140	2816	16	11	7	4	815
15 S C.A.T. (4), high	85 × 130	2938	13.3	7.9	6.1	3.2	815
low	85 × 130	2938	—	—	—	3.6	815
22 S C.A.T (4), high	102 × 140	4576	10	6.3	4.3	2.8	880
low	102 × 140	4576	-	-	—	3.2	880
10-14 Schneider (4)	70 × 120	1843	-			3.5	765
12-15 Schneider (4)	75 × 130	2298	—			3.5	765
15-20 Schneider (4)	80 × 140	2816				3.5	815
16-30 Schneider (4)	83 × 140	3032				3	820
18-24 Schneider (4)	95 × 150	4250				3.25	820
24-40 Schneider (4)	110 × 160	6080	-			3.25	880
20-25 Schneider (6)	75 × 130	3447	-			3.5	820
10 Scout (4)	69 × 125	1868	15.5	9.84	6.92	4	760
12-14 Scout (4)	80 × 130	2610	12.09	4.68	5.4	3.12	810
18-22 Scout (4)	90 × 140	3561	11.6	7.38	5.2	3	815
24-28 Scout (4)	102 × 140	4576	11.6	7.38	5.2	3	820
25 Sheffield-Simplex (6)	89 × 127	4741	11.2	5.86	3.33	—	880
	89 × 127	4741	11.6	5.8	3.33	—	880
30 Sheffield-Simplex (6)	89 × 127	4741	11.8	6.74	4.95	3.3	895
45 Sheffield-Simplex (6)	114 × 114	6960	6.03	3	—	—	895
	114 × 114	[illegible]	10.10	5.28	3	—	895
14-20 Siddeley-Deasy (4)	80 × 130	2610	15.08	9.03	5.66	3.77	815
18-24 Siddeley-Deasy (4)	90 × 130	3307	15.08	9.03	5.66	3.77	815
24-30 Siddeley-Deasy (6)	90 × 130	4960	15.08	9.03	5.66	3.77	825
10 Singer (4)	63 × 88	1096	11.4	7.05	4.72	—	700
14 Singer (4), high	78 × 125	2384	—	—	—	3	810
medium	78 × 125	2384	14.4	7.95	5.43	3.5	810
medium	78 × 125	2384	16.5	9.1	6.2	4	810
low	78 × 125	2384	—	—	—	4.25	810
15 Singer (4), high	80 × 130	2610	16.5	9.1	6.2	3	815
medium	80 × 130	2610	16.5	9.1	6.2	3.5	815
medium	80 × 130	2610	16.5	9.1	6.2	4	815
low	80 × 130	2610	16.5	9.1	6.2	4.25	815
20 Singer (4), high	90 × 130	3307	16.5	9.1	6.2	3	820
medium	90 × 130	3307	16.5	9.1	6.2	3.5	820
medium	90 × 130	3307	16.5	9.1	6.2	4	820
low	90 × 130	3307	16.5	9.1	6.2	4.25	820
25 Singer (4), high	100 × 130	4082	16.5	9.1	6.2	3	895
medium	100 × 130	4082	16.5	9.1	6.2	3.5	895
medium	100 × 130	4082	16.5	9.1	6.2	4	895
low	100 × 130	4082	16.5	9.1	6.2	4.25	895
15-20 Sirron (4), high	80 × 120	2409	12	6.7	3.5	—	810
medium	80 × 120	2409	12	6.7	3.75	—	or
low	80 × 120	2409	12	6.7	4	—	760
18 Sizaire-Berwick	80 × 150	3012	—	—	—	3.3	—

H.P., Name of Car, and Number of Cylinders.	Bore and Stroke.	Cubic Capacity.	Gear Ratios. 1st	2nd	3rd	4th	Rear Tyre Dia.
	mm.	c.c.					mm.
12-15 S.P.A. (4)	70 × 120	1843	-		-	4.46	810
16-20 S.P.A. (4)	85 × 120	2712			-	3.6	815
25-30 S.P.A. (4)	100 × 140	4396				2.7	820
	100 × 140	4396	-		-	2.76	820
50 S.P.A. (4)	110 × 200	7584			-	2.22	880
9.5 Standard (4)	62 × 90	1088	15.5	8.37	4.6	—	700
15 Standard (4)	79 × 121	2368	15.5	8.5	4.5	—	810
20 Standard (4)	89 × 134	3256	13.5	8	5.5	3.5	820
10-12 Star (4)	80 × 120	2109	14	7.8	4.33	—	810
12-15 Star (4)	80 × 120	2109	16.4	9.7	5.8	4.3	810
15.9 Star (4)	80 × 150	3012	15	8.9	5.4	3.9	815
20.1 Star (4)	90 × 150	3816	12.9	7.6	4.6	3.37	820
25-30 Star (4)	108 × 127	4544	12.6	6.2	3.37	2.88	880
23 Star (6)	80 × 120	3614	14.4	8.5	5.1	3.8	820
Stellite (4)	62 × 89	1076	13.7	5.43	—	-	700
Stoddard (4)	102 × 114	3712	11.5	5.5	3.5	-	815
Stoewer (4)	75 × 88	1556	24	11	7	4.33	750
Stoewer (4)	80 × 120	2409	21	11	7	3.75	820
Stoewer (4)	110 × 130	4940	19	10.5	6	3	880
12 Stoneleigh (4)	75 × 114	2016	18	8.43	4.57	-	810
15 Straker-Squire (4) high	87 × 120	2851	10.4	5.2	3.42	-	810
medium	87 × 120	2851	10.98	5.49	3.61	--	810
medium	87 × 120	2851	11.92	5.97	3.92	-	815
low	87 × 120	2851	12.92	6.45	4.25	-	815
15-20 Studebaker (4)	90 × 127	3231	10.4	5.8	3.5	-	760
20-25 Studebaker (4)	105 × 127	4399	13.5	7.4	3.7	—	875
12-16 Sunbeam (4), high	80 × 150	3012	11.4	7.4	5.06	3.4	815
low	80 × 150	3012	11.95	7.84	5.31	3.6	815
16-20 Sunbeam (4), high	90 × 160	4070	11.6	6.6	4.9	3.3	820
low	90 × 160	4070	12.4	7.03	5.2	3.59	820
25-30 Sunbeam (6), high	90 × 160	6105	10.03	5.6	4.2	2.9	880
low	90 × 160	6105	11.6	6.6	4.9	3.3	880
* Super (2)	72 × 120	977	4	—	—	—	650
Swift (2)	75 × 110	971	16.8	7.2	4.2	—	660
10 Swift (4), high	65 × 100	1328	13.75	6.6	3.85	-	700
10 Swift (4), low	65 × 100	1327	14.5	7.76	4.14	—	711
12 Swift (4)	75 × 110	1940	14.4	8.4	5.6	4	760
15 Swift (4)	90 × 120	3052	13.2	7.73	5.15	3.73	815
12 Talbot (4)	80 × 120	2409	14.6	9	6	4	815
15 Talbot (4), high	90 × 140	3561	12.8	7.3	4.7	3.4	815
low	90 × 140	3561	13.6	7.75	5	3.6	820
25 Talbot (4), high	102 × 140	4576	11.3	6.5	4.2	3.05	820
low	102 × 140	4576	11.7	6.9	4.4	3.2	820
20 Talbot (6)	80 × 120	3614	13.6	7.75	5	3.6	820
8 Tiny (2)	85 × 85	964	11.5	8	5		650
18 Thornycroft (4)	101 × 114	3652	13.1	6.84	3.78		815
10 Turner (4)	60 × 100	1128	14.4	5	—		750
	60 × 100	1128	15.1	8.5	5	—	750
	60 × 100	1128	15	9.8	6.5	4	760
12 Turner (4)	69 × 110	1648	16	10.1	6.8	4	760
* Tweenie No. 1 (1)	90 × 120	764	-		-		650
* Tweenie No. 2 (4)	65 × 110	1456					700
8 Tyseley (2)	82½ × 102	1088	9.5	4.5	-	-	650
15 Valveless (2)	113 × 127	2502	13.8	8.8	6.1	4.1	815
19.9 Valveless (2)	127 × 127	3218	13.5	8.5	5.8	3.8	815
16-20 Vauxhall (4)	90 × 120	3052	14.7	9.1	5.8	3.9	815
25 Vauxhall (4), low	95 × 140	3964	11.9	7.6	4.78	3.3	820
high	95 × 140	3964	11.1	7	4.5	3	815
35 Vauxhall (6)	95 × 120	5103	13.7	8.5	5.26	3.6	895
8-12 Vermorel (4)	66 × 120	1640	13	8	6	4	700
12-16 Vermorel (4)	74 × 120	2064	13	7.5	[illegible]	3.75	760
	74 × 120	2064	13	7.5	6	3.75	810
12-14 Vinot (4) high	70 × 110	1689	11.8	4.28	3.57	—	760
medium	70 × 110	1689	12	5.36	3.87	—	760
low	70 × 110	1689	13.2	5.74	4.16	—	760
15-20 Vinot (4) high	80 × 130	2610	10.73	5.88	3.7	—	815
low	80 × 130	2610	12.3	6.37	4	—	815
4 sp. model, high	80 × 130	2610	14.8	9.13	5.84	3.7	815
low	80 × 130	2610	16.2	9.92	6.56	4	815
25-30 Vinot (4) high	101 × 130	4165	14.31	8.22	4.24	3.29	820
low	101 × 130	4165	15.26	8.85	5.6	3.5	820
Vivinus (4)	75 × 110	1940	7.5	4.6	3.9	—	810
Vivinus (4)	90 × 110	2798	6.5	4	3.4	—	815
Vivinus (4)	106 × 120	4224	6.5	4	3.4	—	815
10-15 Vulcan (4)	80 × 120	2409	17.27	7.8	4.29	—	760
15.9 Vulcan (4)	80 × 120	2409	17.14	11.01	6.64	4.29	810
15-20 Vulcan (4)	80 × 150	3012	15.5	9.96	6	3.88	815
25-30 Vulcan (6)	89 × 120	4476	15.5	9.96	6	3.88	875
4½ Wall (1)	89 × 96	597	10	5.75	—	—	650
6 Wall (2)	75 × 80	706	9.25	5.25	—	—	650
8-10 Walcycar (2)	85 × 55	964	10	[illegible]	—	—	650

* Pilot has friction drive. *Rollo has variable pulleys. * Super has belt drive with variable pulleys. * Tweenie has friction drive.

A Tabulated List of Gear Ratios (*Continued*).

H.P., Name of Car, and Number of Cylinders.	Bore and Stroke.	Cubic Capacity.	Gear Ratios. 1st	2nd	3rd	4th	Rear Tyre Dia
	mm.	c.c.					mm.
Warne (2)	85 × 85	964	9	4.5	—	—	—
Waverley (4)........	65 × 130	1728	9.3	5.6	3.9	—	750
Waverley (4)........	75 × 120	2116	9.3	5.6	3.9	—	750
20 Withers (4)	90 × 130	3307	15.43	8.3	4.8	4	820
25 Withers (4)	100 × 130	4082	10.79	6.3	4.37	3.5	880
30 Withers (4)	110 × 130	4940	9.25	5.4	3.75	3	880
35-40 Withers (4)	120 × 130	5876	9.25	5.4	3.75	3	895
*20-30 White (4)	95 × 130	3680	13.8	6.4	4	2.9	875
16-20 Wolseley (4), high	90 × 121	3080	16.5	8.29	5.54	4.12	815
low	90 × 121	3080	17.56	8.82	5.9	4.37	820
24-30 Wolseley (6), high	90 × 130	4961	12.87	7.88	5.42	3.61	895
low	90 × 130	4961	14.48	8.88	6.1	4.06	895
30-40 Wolseley (6) high	102 × 140	6864	—	—	3.2	—	895
low	102 × 140	6864	—	—	3.6	—	895
50 Wolseley (6)	114 × 146	8928	10.9	5.01	3.46	—	935
	mm.	c.c.					mm
14-20 Zedel (4).........	72 × 120	1953	15	8	6	4	760
25-30 Zedel (4).........	90 × 140	3561	13	7.5	5	3	820

Steam and Electric Cars.

H.P., Name of Car, and Number of Cylinders.	Bore and Stroke.	Cubic Capacity.	Gear Ratios. 1st	2nd	3rd	4th	Rear Tyre Dia.
8 Pearson-Cox (3)	43 × 43	—	4	—	—	—	650
Pearson-Cox (3)	61 × 77	—	3.5	—	—	—	810
15 Pearson-Cox (3)	61 × 77	—	3.5	—	—	—	810
*10 Stanley (2)	83 × 108	—	—	—	—	—	810
*20 Stanley (2)	101 × 127	—	—	—	—	—	815
*30 Stanley (2)	127 × 152	—	—	—	—	—	920
10 Turner-Miesse (3)	49 × 79	—	4.6	—	—	—	810
12 Turner-Miesse (3) ...	51 × 79	—	4.6	—	—	—	810
15 Turner-Miesse (3) ...	52 × 79	—	4.6	—	—	—	805
20 Turner-Miesse (3) ...	59 × 89	—	4.6	—	—	—	820

* The 20-30 h.p. White has direct drive on third speed. * Stanley has a double-acting engine.

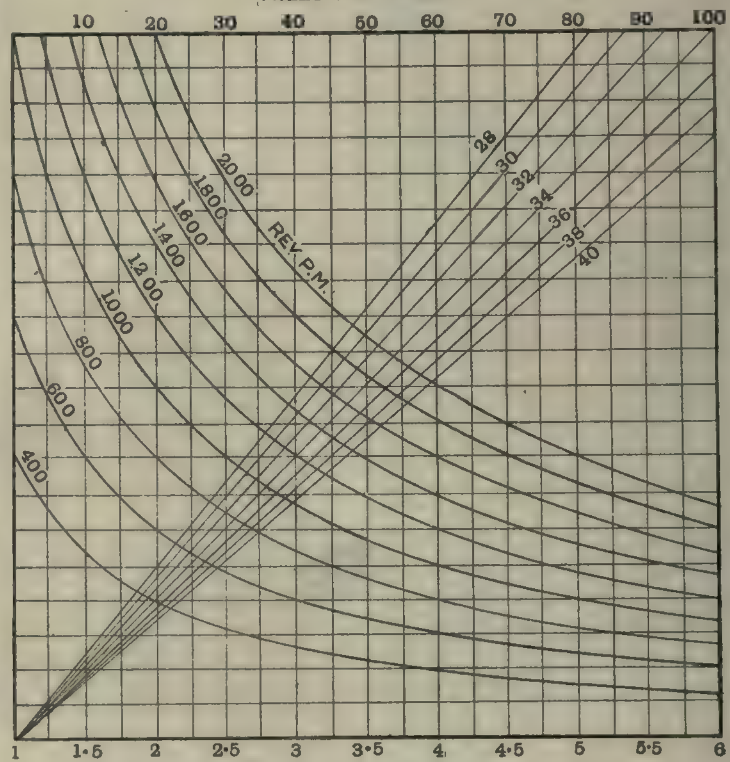
Engine R.P.M. at Various Road Speeds.

The accompanying diagram has been designed with the object of facilitating to the last degree of simplicity the work of ascertaining the number of engine revolutions per minute at various road speeds. It is only necessary to know the road speed, wheel diameter, and gear ratio, and then the engine speed can be ascertained. For instance, a motorist may desire to know the speed of his engine in revolutions per minute when his car is travelling at a certain speed in miles per hour. By the usual method of obtaining this information a considerable amount of calculation would be required, but with the diagram herewith the most unskilled in mathematics can surpass in point of time the most facile slide rule operator in obtaining the desired result. To find on the accompanying curve the number of revolutions per minute that the engine is making at any speed, find the miles per hour on the top line and follow the vertical line down until it cuts the wheel diameter line. Then move along a horizontal line until a point vertically above the gear ratio on the bottom line is arrived at. The engine revolution curve which passes through this point, or would pass through it if drawn up, gives the required engine speed.

For instance, a car is proceeding at thirty miles per hour; it has 32in. wheels and a 3 to 1 gear ratio. What is the engine speed? Proceed along the top line till we strike fig. 30; drop vertically till the 32in. wheel line is reached. Then work horizontally till the vertical line is met from the gear ratio number 3 on the base line. The nearest engine revolution curve will show that the engine speed is nearly 1,000 revolutions per minute.

If any three of the four quantities—gear ratio, speed of car, wheel diameter, and engine speed—are known, the fourth one can be found by inspection. Engine speed in revolutions per minute is, however, the factor usually required; we have therefore taken that for our example. The following is a conversion table for wheel diameters, which may prove useful in connection with this chart:

MILES PER HOUR.



TOP GEAR RATIO.

A Curve from which, when the Details of any Three are known, either the Engine Speed, Speed of the Car in M.P.H., Wheel Diameter, or Gear Ratio, may be obtained.

Mm. In.	Mm. In.	Mm. In.	Mm. In.	Mm. In.
650 = 25.6	760 = 30	820 = 32.3	880 = 34.6	965 = 38
700 = 27.5	800 = 31.5	863 = 34	895 = 35.25	1018 = 40
710 = 28	810 = 32	870 = 34.25	920 = 36.2	
750 = 29.5	815 = 32.2	875 = 34.5	935 = 36.8	

Motor Associations, Societies, and Clubs.

(British and Greater British.)

Particulars of the Objects, Conditions of Membership, Headquarters, etc., of the various Automobile Bodies.

Section I.—Home.

The National Automobile Council.

(Inaugurated December, 1911.)

SECRETARY: Mr. J. W. Orde, 90, Pall Mall, London, S.W.

The following bodies are represented on the N.A.C.:

- The Auto-Cycle Union.
- The Commercial Motor Users' Association.
- The Institute of British Carriage Manufacturers.
- The Institution of Automobile Engineers.
- The London Omnibus Owners' Federation.
- The Royal Automobile Club and Associated Clubs.
- The Scottish Automobile Club.
- The Irish Automobile Club.
- The Society of Motor Manufacturers and Traders, Ltd.

The National Automobile Council was not hastily formed by any means. For some time previous it had been felt that if the interests of the movement were to receive due recognition at the hands of the authorities it was necessary that means should be found by which the numerous bodies representative of the various aspects of automobilism should be able to meet and consult, with a view of taking united action in matters of first importance. The Royal Automobile Club took the initial steps in June of 1911.

The draft scheme provided that the functions of the Council should be mainly deliberative, and that no interest or organisation should be bound by the majority, but that where it was found possible, as the result of the deliberations of the Council, to arrive at a unanimous decision in regard to any matter of legislation or taxation, the views of the Council should be put forward in its name as representing the views of the automobile movement as a whole.

The following are the objects of the Council:

(a) That the Council should consider matters of legislation and taxation.

(b) That the findings of the Council be submitted to the constituent bodies for their consideration, and in all cases where unanimity is reached the decisions of the Council shall be put forward in the manner provided in clause *(e)*.

(c) That each of the constituent bodies, as the meetings of the Council may be irregular in date and may be called to meet an emergency, should nominate a panel of at least twelve delegates, and from among those best qualified, having regard to the subject to be discussed, each body could select three delegates for any particular meeting of the Council. Each delegate should represent one body only at any one meeting of the Council.

(d) That the Council shall choose at its first meeting in each year its own chairman for the year, who may be chosen from outside any of the panels.

(e) That the Royal Automobile Club should place its committee room at the disposal of the Council, convene all meetings when required by any one of the constituent bodies, provided that the chairman of the Council is of opinion that the subject proposed for discussion comes within the terms of reference, and give effect in the name of the Council to the decisions of the Council by placing its organisation at the disposal of the Council for all purposes of executive action.

The one thing which detracts from the value and possibilities of the N.A.C. is the fact that the Automobile Association and Motor Union has refused to join, on the grounds that the system of representation on the Council is not fair.

Royal Automobile Club.

MEMBERS' HEADQUARTERS: Pall Mall, London, S.W.

ASSOCIATES' HEADQUARTERS: Pall Mall, London, S.W. (Western Entrance).

PATRON: His Majesty the King.

PRESIDENT: H.R.H. the Duke of Connaught, K.G.

VICE-PRESIDENTS: The Earl of Derby, G.C.V.O., C.B.; the Earl of Dudley, G.C.M.G., G.C.V.O.; Lord Montagu of Beaulieu; Sir David L. Salomons, Bart.; Col. Mark Mayhew; Mr. Alfred F. Bird, M.P.; and Mr. Roger W. Wallace, K.C.

CHAIRMAN: The Hon. Arthur Stanley, M.V.O., M.P.

VICE-CHAIRMEN: Mr. A. Armitage, Col. Sir D. A. Kinloch, Bart., C.B., M.V.O., and Mr. G. Holt Thomas.

MEMBER OF ALL COMMITTEES: Col. H. C. L. Holden, C.B., F.R.S.

HON. TREASURER: Mr. Paris E. Singer.

HON. CONSULTING ENGINEER: Mr. W. Worby Beaumont, M.Inst. C.E., M.I.Mech. E.

HON. ARCHITECT: Mr. E. Keynes Purchase, F.R.I.B.A., F.S.I.

HON. LIBRARIAN: Mr. Herbert S. Stoneham.

LEGAL ADVISER: Sir T. H. D. Berridge.

AUDITORS: Messrs. Andrew W. Barr and Co.

SECRETARY: Mr. J. W. Orde.

The Royal Automobile Club was founded in December, 1897, and for the first few years its home was in Whitehall Court, London, S.W. The rapid rise in membership necessitated a migration, and in December, 1902, 119, Piccadilly, was opened to members. Then 18, Down Street, had to be utilised, not only as a motor house, but as offices; also part of 16, Down Street; and 108, Piccadilly. In 1908 the Scheme of Association—instituted to throw more responsibility on the provincial clubs—made it necessary to take 112, Piccadilly, as the headquarters of the associates. To-day the Club is housed in the palatial building in Pall Mall, erected by the Club, and specially adapted to its needs.

The Pall Mall building contains complete accommodation for the members, namely, reading, dining, smoking, billiard, card, and committee rooms, an up-to-date restaurant, the "Great Gallery" for receptions and concerts, about one hundred bedrooms, library, fencing room, swimming bath, Turkish bath, electric light bath, squash racquet courts, rifle range, physical culture room, bowling alley, photographic studio, and so forth, thus catering for the tastes of all. The official motor house of the Club is at "Niagara," York Street, Westminster, S.W. A Government post office is installed at the Club—the only one of its kind in the United Kingdom—solely for the convenience of members. Here all the usual business of a post office is undertaken with the exception of the issue of licences. Another feature is a typewriting bureau for the use of members.

All the departments of the Club are now housed under one roof, namely, Engineers (whose services are at the disposal of members and associates), Legal (with a fully qualified solicitor in charge), Touring (the issue of triptyques, preparation of routes, transport of cars, and general touring information), Associates, Driving and Mechanical Proficiency Certificates, Agenda (which is also the Roads, Competitions, and Press Department, Year Book Office, etc.), Technical (for certified trials and technical tests, etc.), Accountants, etc., and offices are also located to the Auto Cycle Union and the Commercial Motor Users' Association.

The Club has a membership of 7,700, and is the largest of all the automobile clubs in the world. Members and associates together number over 40,000, not including the membership of the large number of foreign and colonial clubs affiliated to the parent body. It has enclosures or other facilities at Ascot, Hurst Park, Lingfield Park, Brooklands, Henley Regatta, Richmond Horse Show, Olympia Motor Show, and at other meetings. The R.A.C. Golfing Society was formed in the early part of 1910, and has proved a popular feature of the sporting side of the Club's life.

The Club is the property of the Automobile Proprietary, Ltd., which consists solely of the members themselves, who assume a liability limited to £1, which is covered by the first annual subscription. It is governed by a committee consisting of fifty members elected by the membership.

The Club is the representative of the United Kingdom on the International Association of Recognised Automobile Clubs.

Its objects are the encouragement and development of the automobile movement; the provision for its members of a social club, and a centre of information and advice on matters pertaining to automobilism; and the advantage of its support in the protection and defence of their rights. The leading characteristics and advantages of the Club are as follow:

(a) It is a members' club.

(b) It provides—

(1) A suitable Club-house in London, with the usual social and residential accommodation and sporting facilities.

Associations, Societies, and Clubs.

(2) A Club library, containing maps, handbooks, and other touring and technical information, and general literature.

(3) A motor house adjacent to the Club for the storage of members' motor vehicles.

(4) A Club engineer, to examine cars and give advice; and apparatus for testing purposes.

(5) A Club journal to members and associates free of cost.

(6) An Automobile Year Book, free to members and associates.

(7) Instruction in driving cars, and the issue of international passes and driving certificates which will be accepted by the authorities abroad.

(8) A register of motor servants.

(9) Touring and customs facilities for members and associates desiring to travel abroad.

(10) Distinguishing badges for members and associates in order to facilitate their recognition.

(c) It affords members and associates information and advice connected with the automobile movement.

(d) It organises trials and competitions from time to time.

(e) It holds lectures and discussions.

(f) It cultivates reciprocal relations with kindred institutions at home and abroad.

(g) It generally protects and encourages automobilism.

The Club consists of *(a)* Founder Members, *(b)* Life Members, *(c)* Honorary and Temporary Honorary Members, *(d)* Town and Country Members, *(e)* Supernumerary Members, and *(f)* Temporary Colonial Members.

Applicants for membership must be proposed by two members of the Club, and their names and addresses and description of profession or calling must be displayed on the Club premises for at least ten days prior to the day of election. There is also a Candidates' Book at the Club.

Entrance Fee: For both town and country members, 25 guineas

Subscription: Town members, 10 guineas; country members, 5 guineas.

The Committee may elect as Temporary Honorary Members persons generally resident abroad for a period not exceeding two months during their sojourn in this country. The Committee may also elect Ambassadors, Ministers, or other representatives of foreign countries, the Colonies, and India, as Temporary Honorary Members, and may elect the Secretaries, Attachés, etc., to membership without entrance fee, during the period of their official residence in this country. The Committee may also elect as Temporary Honorary Members for a period not exceeding twenty-eight days in any one year representatives of associated or affiliated clubs.

The annual subscription for Associateship is one guinea, which holds good for twelve months from the date of payment, and it confers the following among other advantages:

(a) The services of the R.A.C. Touring Guides on the road.

(b) Assistance in case of breakdown on the road. ("The Badge that will Get You Home.")

(c) Free legal defence by a solicitor in any police court in the United Kingdom. Free legal advice and assistance.

(d) The services of the R.A.C. Touring Department for tours at home or abroad.

(e) The R.A.C. "Model" Car Insurance Policy.

(f) Advice on the purchase, sale, or maintenance of cars.

(g) Reading and Writing Room in the R.A.C. Club House in Pall Mall (Western Entrance).

The Automobile Association and Motor Union.

HEAD OFFICES: Fanum House, Whitcomb Street, Coventry Street, London. *Telegrams:* Fanum, London. *Telephone:* Regent 300.

CITY OFFICES: Guildhall Annexe, Guildhall Yard, E.C. *Telegrams:* Guilfanum, London. *Telephone:* 5692, London Wall.

The A.A. and M.U. also has offices at Manchester, Liverpool, Leeds, Birmingham, Norwich, Exeter, Cardiff, Bristol, Swansea, Plymouth, Dublin, Belfast, Cork, Glasgow, Edinburgh, and Paris.

PRESIDENT: The Earl of Lonsdale.

VICE-PRESIDENT: The Earl of Donoughmore.

CHAIRMAN: Mr. W. Joynson-Hicks, M.P.

VICE-CHAIRMEN: Sir Archibald J. Macdonald, Bart., J.P., and Mr. C. H. Dodd.

HON. TREASURERS: Messrs. W. Ballin-Hinde and L. Schlentheim.

SOLICITORS: Messrs. Amery-Parkes and Co., 18, Fleet Street, E.C.

AUDITORS: Messrs. Newson-Smith, Lord, and Mundy, 37, Walbrook, E.C.

BANKERS: Messrs. Barclay and Co., Ltd., 19, Fleet Street, E.C.

COMMITTEE: Messrs. D'Arcy Baker, S. F. Edge, Walter Gibbons, Alfred Harris, Rev. F. W. Hassard-Short, Charles Jarrott, J. Kennedy, Dr. J. L. Lock, Charles McWhirter P. A. Sharman, and Charles Temperley.

MOTOR CYCLE SUB-COMMITTEE: Mr. Charles Jarrott, Rev. F. W. Hassard-Short, and Mr. Robert W. Head.

SECRETARY: Mr. Stenson Cooke.

The A.A. and M.U. is an organisation formed as the result of an amalgamation between two important bodies, namely, the Automobile Association and the Motor Union. Motor cyclists as well as motor car owners are eligible for membership.

At the end of 1913 the total membership was over 72,000.

Among the chief objects of the Association are the protection and extension of the rights and privileges of motorists, the creation of a better understanding between all users of the road, and the repression of improper and inconsiderate driving.

The patrol organisation is the chief feature of the Association's work. This organisation now extends over thousands of miles of main roads, and the full staff is now being kept on the roads right through the winter months. The cost of the patrol organisation in wages alone amounts to over £30,000 per annum.

The duties of the patrols are to give members information of interest concerning the road, warn them of any dangers on the highway, and render them all possible assistance in case of need. The men are specially selected for their ability to undertake minor roadside repairs, and the committee feels that the extraordinary success of the Association is chiefly due to the popularity of this portion of its work. The patrols are also equipped with first-aid wallets, which are at the service of all users of the highways.

A system of roadside telephones has been established to enable members to ring up garages for assistance, supplies, etc., or to obtain hotel accommodation in advance of their arrival. These telephones are free to the use of members.

Every member is entitled to the advice of the A.A. and M.U. solicitors upon any question arising under the Motor Car Act, 1903, and to be defended by them or a duly appointed agent in any proceedings under the Act in any police court in the United Kingdom, in respect of offences alleged to have been committed by him or his driver during his period of membership.

The Free Legal Defence Scheme has now been in force for nearly five years, and the very high percentage of successes achieved shows conclusively that it fills a real need. Members are entitled at all times to the advice and assistance of the Legal Department on any question respecting motoring, or the use and ownership of motor vehicles.

The A.A. and M.U. hotel system extends throughout England, Wales, Scotland, and Ireland. The hotels are very carefully selected, passed, and classified on a five star basis by a special Hotels Committee before appointment. Toilet boxes, containing hand towels, combs, and brushes, are also fixed in hotels specially for the use of members.

Agents and repairers are distributed throughout Great Britain in all the important cities and towns and in numerous hamlets at intervals of a few miles along every main road in the kingdom. The system is now spread over 20,000 miles of road, and all the agents are in direct touch with a central department. The agents report periodically to the head office concerning the condition of the roads in their districts, and other local information of interest, which is always at the disposal of members.

Members can obtain at all times reliable road information and detailed itineraries of routes throughout the United Kingdom from the Touring Department, where an expert staff is in constant communication with agents, hotels, and special touring representatives throughout the country.

The Continental Touring Department assists members touring abroad with their cars. They can deposit with the Association the duty payable, and obtain triptyques or entry permits for their cars, which are recognised by the foreign customs authorities at each frontier. The whole of the duty is refunded on the return of the triptyque duly discharged to the Association. Arrangements have been made for shipment of members' cars on every steamship route to the Continent, and agents have been appointed at all the foreign ports, who meet members on arrival and render assistance in getting the car through the customs.

International passes can be issued to any motorist whose driver and car have been certified by the Association's examiners. These passes obviate the necessity of taking out driving licences or of registering cars in nearly all the countries on the Continent.

A.A. and M.U. agents and hotels have been appointed in all the principal towns in France, Germany, Italy, and Switzerland, Belgium, and Holland, where members will receive special attention. This system is being rapidly extended all over the Continent.

Much valuable and practical work has been accomplished by the Association in erecting village signs, direction signs, school signs, and other road warnings, and where, at night time, motorists might run into danger, illuminated signs are being put up.

Members requiring competent drivers and mechanics can obtain assistance from the Drivers' Department of the Association, which is working in conjunction with the Society of Automobile Mechanic Drivers, through which body suitable men are obtained for members.

The work of the Association also includes: Opposing applications for unnecessary speed limits. Watching over the interests of motorists in Parliament. Protecting motorists from the imposition of illegal or excessive bridge, ferry, and road tolls, and other dues and imposts. Discouraging and preventing inconsiderate and dangerous driving, both of motor cars and other vehicles. Agitating for better regulations for the lighting of all vehicles on public roads. Agitating for the proper limitation and apportionment of the taxation on motor cars and other vehicles, and generally of undertaking such work on behalf of motorists as can only be discharged by a strong and united body representative of all classes of motorists in the United Kingdom. Also securing just and impartial administration and enforcement of the laws affecting all users of the highway.

Annual subscription: Car owners, £2 2s.; Irish, colonial, and foreign members, £1 1s.; motor cyclist and cycle car members, 10s. 6d.

The Institution of Automobile Engineers.

13, Queen Anne's Gate, Westminster, London, S.W.

PRESIDENT: Mr. J. S. Critchley (London).

VICE-PRESIDENTS: Colonel H. C. L. Holden (London), Messrs. Max Lawrence (Manchester), and Mervyn O'Gorman (London).

SECRETARY: Mr. Basil H. Joy, 13, Queen Anne's Gate, Westminster, London, S.W.

The principal objects for which the Institution was established are:

To promote the science and practice of engineering as applied to the construction of automobiles, all forms of self-propelled and mechanically-propelled vehicles, motors, and to every kind of mechanical locomotion on land, on, or in, water, or in air; and to initiate and carry through any scheme or to organise any movement likely to be useful to the members of the Institution and to the community at large in relation thereto.

To hold meetings of the Institution for reading and discussing communications bearing upon engineering as applied to the matters enumerated above, or the applications thereof, or upon subjects relating thereto.

To enable engineers to correspond, and to facilitate the interchange of ideas respecting improvements in the various branches of the practice of engineering as applied to mechanical locomotion, and the publication and communication of information on such subjects to the members.

To establish scholarships, organise lectures, hold examinations, to grant premiums and prizes for papers and essays, and by any other similar means to enlarge the knowledge and improve the practice of engineering as applied to mechanical locomotion.

The Institution consists of Ordinary Members, Associate Members, Graduates, and Associates.

Candidates for admission as Ordinary Members must be persons not under twenty-five years of age, who, having occupied during a sufficient period a responsible position in connection with the practice of engineering as applied to mechanical locomotion, or otherwise proved their thorough knowledge of the theory and practice of automobile engineering, may be considered by the Council qualified for election.

Candidates for admission as Associate Members must be persons not under twenty-three years of age, who shall have been trained as engineers, and who shall be able to satisfy the Council that they have subsequently been employed in the practice and science of engineering as applied to mechanical locomotion for at least two years, and shall be actually engaged in the work of such engineering at the time of their application for election, and are considered by the Council to be qualified for election. They may be transferred at the discretion of the Council to the Class of Members.

Graduates must be persons under twenty-six who, at the time of election, are being trained as pupils to an automobile engineer, or are studying engineering as applied to mechanical locomotion, or who otherwise satisfy the Council that there are special circumstances which, in the opinion of the Council, entitle them to admission.

Candidates for admission as Associates must be persons not under twenty-five years of age, who, by reason of their scientific attainments or their position in the engineering industry as applied to mechanical locomotion, may be considered eligible by the Council, or persons not under the said age and not in the industry who, for the interest they take in mechanical locomotion, may be considered eligible by the Council.

The Council have the power to elect as Honorary Members persons who, by reason of their past services to automobile engineering, or by other eminent qualification, are, in their opinion, eligible for that position.

Subscriptions: Ordinary Members, 3 guineas a year; Associate Members, 2 guineas a year; Associates, 2 guineas a year; Graduates, half-a-guinea a year; Life Composition Fee, £35.

Brooklands Automobile Racing Club.

OFFICES: Carlton House, Regent Street, London, S.W.

MOTOR COURSE AND FLYING GROUND: Weybridge.

PRESIDENT: The Earl of Lonsdale.

VICE-PRESIDENT: Lord Montagu of Beaulieu.

CLERK OF THE COURSE: Major F. Lindsay Lloyd.

SECRETARY: Mr. Kenneth L. Skinner.

This Club was established in 1907 for the purpose of promoting races between mechanically-propelled contrivances of all descriptions.

Race meetings are regularly held throughout the summer months, the programmes including races for motor cars, motor cycles, and, latterly, aeroplanes.

The subscription to the Club is four guineas, with a reduction of one guinea in the case of members of the Royal Automobile Club, the Royal Aero Club, the Automobile Association and Motor Union, and the Motor Club. There is also an entrance fee of two guineas.

Members have the privilege of using the track at any time, and of visiting the flying ground. They also have admission for themselves and their cars to all race meetings held at the course under the auspices of the Club. Each member secures also the same privileges for two ladies.

The races at the various meetings are, generally speaking, open to all comers, but in order to differentiate between competitors interested in the motor industry, who have at their disposal the resources of factories and numerous workers, and the private individual who has no such resources, the committee of the B.A.R.C. has established a body called "Private Competitors," on the general lines of "Gentlemen Riders of the Turf." A private competitor requires re-election annually, and he need not be a member of the Brooklands Automobile Racing Club.

The track itself is about two and three-quarter miles long and 100 feet wide, the surface being composed of cement. It is of an irregular oval shape, one curve being of a much greater radius than the other. Crossing the oval near the smaller curve is a straight portion, known as the finishing straight, upon each side of which the spectators assemble to witness the motor races.

The track is scientifically banked at the curves, so that the greatest speeds can be attained upon it in safety, and it may be remarked here that a Benz car in November, 1909, accomplished half a mile at a speed of 127.877 miles an hour.

The track has been furnished with a complete equipment of Col. Holden's electrical timing apparatus for the accurate timing of cars while travelling at speed. So sensitive is the mechanism that the results can be accurately certified to within a 1,000th of a second.

The Brooklands motor course has become the recognised venue for tests and trials of cars, and has proved itself of inestimable value in the promotion of the development of the British motor industry.

The ground surrounded by the motor course has been levelled, and is the most important aviation ground in this country. The forty aeroplane sheds are generally occupied, and most of the leading makes of aeroplanes are to be seen in flight when the weather and other conditions are favourable.

The charges for admission to non-members are: On race days, 2s. 6d. and 10s.; cars are admitted alongside the course at a charge of 10s., or may be left in the garage at a charge of 2s. 6d. On non-race days, the charge for admission is 1s.,

Associations, Societies, and Clubs.

and a further charge of 2s. 6d. is made for cars proceeding to the flying ground.

The charge for the use of the motor course is £1 a day, and books of twelve tickets can be obtained for £4 10s. on application to the London office.

In addition to the race meetings held by the Brooklands Club, the British Motor Cycle Racing Club holds monthly motor cycle race meetings during the summer months, and other race meetings are occasionally held at Brooklands by the Royal Automobile Club, the Motor Cycling Club, and other important motoring bodies.

The Roads Improvement Association (Incorporated).

15, Dartmouth Street, Westminster, London, S.W.

Established in 1886, and formally incorporated in 1898, the Roads Improvement Association has for over twenty-six years promoted the movement for better, wider, dustless, and more conveniently planned roads and footways. As the national and representative organisation of all classes of road users, its fundamental aim has been to unite all forms of road traffic in the common cause of obtaining improved roads and additional facilities for traffic thereon.

To-day the Association numbers amongst its constituent and supporting bodies the national organisations representing owners and users of pleasure motor cars, horse-drawn conveyances, cycles, motor cycles, commercial motor vehicles, motor cabs, public service vehicles and traction engines. Over 200,000 users of the public highways are represented by the Association.

Exceptional success has attended the Association's efforts to modernise the system of highway administration, to develop ways and means of dealing with the dust nuisance, to increase the knowledge available upon all road matters, and to obtain for the road user consideration for his views and requirements from the responsible authorities.

There are many provincial branches throughout the country.

H.R.H. Prince Arthur of Connaught, K.G., K.T., G.C.V.O., is the president of the Association, and its vice-presidents are the Hon. Arthur Stanley, M.V.O., M.P., Lord Montagu of Beaulieu, W. Joynson-Hicks, M.P., and Ed. Manville, M.I.E.E. For its chairman it has Mr. Robert Todd, who for years has been known as an enthusiast in road matters; its vice-chairmen comprise Colonel R. E. Crompton, C.B., M.Inst.C.E., well known as the consulting engineer of the Road Board, and Mr. H. Percy Boulnois, M.Inst.C.E., late chief engineering inspector at the Local Government Board and a member of the Road Board's Advisory Committee of Engineers. Mr. E. S. Shrapnell-Smith, as honorary treasurer, represents the claims of the commercial motor vehicle, and Mr. Wallace E. Riche acts as secretary. The Council, a comparatively large one, consists of representatives of the Royal Automobile Club, the Automobile Association and Motor Union, the Cyclists' Touring Club the National Cyclists' Union, the Commercial Motor Users' Association, the National Traction Engine Owners' and Users' Association, the Incorporated National Union of Horse and Vehicle Owners, and three others representing individual members.

The establishment of the Road Board to distribute an Imperial Road Improvement Fund (amounting to at least £600,000 per annum) to assist the local authorities to improve their highways is the direct result of the Association's strenuous advocacy for State assistance for the roads.

The standard of efficiency in construction and maintenance has been greatly raised during recent years, largely in consequence of the vigorous campaign that has persistently been conducted for the use of up-to-date methods to meet modern traffic requirements. The Association initiated and carried out the first experiments in this country to fix the surface dust, and it has fostered by every means within its power every development to minimise the dust nuisance.

Local road improvements, such as the removal of dangerous corners, cutting of hedges, filling-in of ditches, reduction of dangerous camber, rolling-in of loose metal, repair of defective tramlines, the strengthening of weak bridges, etc., are frequently being obtained. Negotiations with local authorities, land owners and other interests, are in progress daily to secure these improvements. This department of the Association's activities is now being greatly increased.

Conferences have been held, discussions and meetings organised, exhibitions supported, papers on various aspects of the road question read before learned societies by members of the Council of the Association, and every possible opportunity of raising the road question to one of foremost importance, in order to gain for it the attention it deserves, has been utilised.

The Association has always acted to the fullest extent of its limited resources as a Central Intelligence Department upon all matters appertaining to the construction, maintenance, and administration of the highways.

The R.I.A.'s branch organisations throughout the country will be developed and extended; local road users will thus be enabled to take a greater interest in the improvement of their roads and the free and safe passage of all traffic thereon. Further, the Council of the Association will be able to act more effectively in local matters generally. This work is specially important if road users are to obtain the fullest benefits from the distribution of the Imperial Road Improvement Fund and the expenditure of the highway rates.

Efforts will be made to obtain further national reforms in the administration of the highways. A new Highway Bill is being prepared.

Schemes for the construction of new and wider exits from the Metropolis and other big cities, also for the improvement of the arterial roads throughout the country, will be energetically promoted. Great extensions will also be made in the movement to obtain road improvements of local or inter-district importance; this has always formed an important feature of the R.I.A.'s work, but there is an enormous field for development, and as the Association's branches are increased and strengthened, this work will grow accordingly.

The membership subscription has been fixed at the nominal sum of 5s. per annum to enable all classes of road users to lend their support, but it is hoped that all who can afford it will become subscribers of at least £1 1s. per annum.

The Society of Motor Manufacturers and Traders, Ltd.

This Society for the protection, encouragement, and development of the automobile industry was formed in July, 1902. It represents all branches of the industry, but the Retail Section has, with the full concurrence and approval of the Society, recently formed a separate organisation which has taken the place of the Agents' Section and Local Sections of the Society.

There is a Council representative of all the interests, and a Management Committee on which every section is also represented. In addition there are nine Section Committees, namely:

Accessories and Components Committee.
Aero Committee.
British Manufacturers' Committee.
Carriage Builders' Committee.
Commercial Vehicle Committee.
Foreign Manufacturers' and Concessionnaires' Committee.
Marine Committee.
Tyre Committee.

There is also a Standardisation Committee, which works in connection with the Engineering Standards Committee and the Institution of Automobile Engineers.

The Society is affiliated to the London Chamber of Commerce, and there is a Standing Joint Committee with the Royal Automobile Club for the purpose of discussing matters affecting the industry.

As the representative body of the motor trade in this country, the Society is represented on the International Union of Motor Trade Associations, the Committee of which meets in turn in the various countries of Europe affiliated to the Union.

The motor exhibitions of the Society have, since 1904, been held at Olympia, but in addition to the Motor Car Exhibitions held in November, the Society has organised at the request of the various Committees of Sections, Exhibitions of Commercial Vehicles, Aeroplanes, Motor Boats and Engines, etc.

The Register of the Motor Trade, compiled and issued by the Society to members only, is a classified list of practically the whole of the firms engaged in the trade throughout the country. Enquiries with regard to any firm not contained in this Register are dealt with by a special department, but such enquiries are not undertaken with regard to the financial status or otherwise of any firm, but simply to ascertain the nature of their motor business.

The Society is also able to answer enquiries for the makers of any special motor goods, or for the source of supply of raw material, or practically any article required by the trade, also to give information with regard to colonial and foreign tariffs on motor goods and other information of value to members doing business abroad.

The finances of the Society are looked after by a special Finance Committee, the chairman of which is Mr. D. Citroen, the hon. treasurer of the Society. The funds have been used for matters of general interest, as in legal cases where points of principle are involved, the joint Fuel Committee with the N.A.C. and the A.A. and M.U., etc., and in support of the Cycle and Motor Trades Benevolent Fund and other bodies.

The president of the Society is Mr. S. F. Edge, and the vice-presidents, Mr. A. Brown and Mr. E. M. C. Instone. Secretary, Mr. T. F. Woodfine, Pall Mall, London, S.W.

The Imperial Motor Transport Council.

PRESIDENT: H.R.H. Prince Arthur of Connaught, K.G.

VICE-PRESIDENTS: The Rt. Hon. Lewis Harcourt, M.P., Secretary of State for the Colonies; Col. the Rt. Hon. J. B. Seely, M.P., Secretary of State for War; the Rt. Hon. the Marquess of Crewe, K.G., Secretary of State for India; the Rt. Hon. Herbert Samuel, M.P., Postmaster-General; the Rt. Hon. Sydney Buxton, M.P., President of the Board of Trade; the Rt. Hon. the Lord Strathcona, G.C.M.G., G.C.V.O., etc., High Commissioner for the Dominion of Canada; the Rt. Hon. Sir George Reid, G.C.M.G., High Commissioner for the Commonwealth of Australia; the Hon. Thomas Mackenzie, High Commissioner for the Dominion of New Zealand.

HON. SECRETARY: Mr. Horace Wyatt.

The meetings are held at the Royal Automobile Club, Pall Mall, London, W.

The Imperial Motor Transport Council is the outcome of the very successful Imperial Conference that was held in London in July, 1913, at the time of the Olympia Commercial Vehicle Show, and it is the result of a resolution passed by some two hundred colonial delegates who attended that Conference.

The principal objects of the Imperial Motor Transport Council are:

1. To act, in the words of Lord Crewe, as "a clearing house of ideas" on all matters relating to motor transport throughout the Empire. To advise and consult with associated bodies and correspondents throughout the Empire, who may require information on questions coming within the scope of the Council, or who may desire to put before manufacturers statements of the conditions and requirements existing in various portions of the Empire.

2. To organise further conferences when such appear advisable in the interests of manufacturers and users.

3. To form expert committees to consider any special matters of importance to which the attention of the Council may be drawn by corresponding members or associated bodies.

4. To publish periodical reports from information received through the medium of a system of correspondents throughout the Empire, and to arrange for the publication of matters, relating to motor transport, which would benefit by publicity.

To enable the Council to deal promptly with enquiries relating to the selection of industrial motor vehicles for service abroad, or the operation of vehicles in such service, a small Technical Enquiries Sub-committee has been formed. This Sub-committee consists of—Chairman, Mr. W. Worby Beaumont, M.I.C.E., etc., consulting engineer to the Chief Commissioner of Police and to the Royal Automobile Club; Mr. Ashton M. Heath, A.M.I.C.E., chief inspecting engineer to the Crown Agents for the Colonies; Mr. H. E. Wimperis, inspecting engineer to the Crown Agents for the Colonies; Mr. Horace Wyatt, the honorary secretary of the Council, will also act as honorary secretary of the Sub-committee. The advice of the Sub-committee, and if necessary of the Council as a whole, upon technical matters of this kind will be given without charge, unless the enquiries involve so much lengthy investigation as to make this course impossible.

The Council is in course of forming an Alcohol Motor Fuel Committee in accordance with the request of the delegates at the recent Conference. This committee will conduct investigations and experiments relating to the use of alcohol as a motor fuel, the general opinion having been expressed by delegates at the Conference that considerable support would be forthcoming from the Dominions and Colonies in aid of work assisting towards the production of a permanent adequate supply of fuel within the Empire.

The Brooklands Test Hill.

A Vauxhall car ascending the Brooklands test hill. The average gradient is practically 1 in 5, and the maximum 1 in 4. The photograph from which this illustration is reproduced was taken in the summer of 1913, on the occasion of the annual gathering of the Royal A.C. and its associated clubs—one of the most popular social meetings of the year.

Section II.—Colonial and Foreign Clubs.

[Section I. contains a summary of the principal home clubs and governing bodies. It will be found on pages 111-115.]

R.A.C. of South Africa—
Headquarters: National Mutual Buildings, Church Square, Capetown.
Hon. Secretary: Mr. Donald A. McIntyre, P.O. Box 1,035, Capetown.

Natal A.C.—
Headquarters: 49, Tenth Avenue, Durban.
Hon. Secretary: Mr. G. E. Watts.

A.C. of Rhodesia—
Headquarters: Bulawayo.
Hon. Secretary: Mr. A. E. Knowles.

Transvaal A.C.—
Headquarters: Grand National Hotel, Johannesburg.
Secretaries: Mr. T. Greig and Mr. P. Wilkinson, P.O. Box No. 2,154, Johannesburg.

A.C. of Australia—
Headquarters: Challis House, Martin Place, Sydney, N.S.W.
Secretary: Mr. H. C. Morgan.

A.C. of Victoria—
Headquarters: 91, Elizabeth Street, Melbourne, Victoria.
Secretary: Mr. H. W. Chenoweth.

A.C. of Queensland—
Headquarters: Eagle Chambers, Brisbane, Queensland.
Secretary: Mr. David Service.

A.A. of South Australia—
Headquarters: Steamship Buildings, Currie Street, Adelaide.
Secretary: Mr. A. Laughton.

A.C. of Western Australia—
Headquarters: St. George's Terrace, Perth.
Hon. Secretary: Mr. S. D. Eden.

A.C. of Tasmania—
Headquarters: Hobart.

A.C. of Canada—
Headquarters: Montreal.
Secretary: Mr. G. A. McNamee.

Ontario Motor League—
Headquarters: Toronto.
Secretary: Mr. E. M. Wilcox, 118, Stair Buildings, 123, Bay Street, Toronto.

Vancouver M.C.—
Headquarters: Vancouver, B.C.
Secretary: Mr. C. W. Draper, 2, Imperial Block, Pender and Seymour Streets, Vancouver.

A.C. d'Egypte—
Headquarters: 27, Chareh-el-Madabegh, Cairo.
Secretary: M. le Baron E. G. Rey.

A.C. of Ceylon—
Headquarters: Queen's Hotel, Kandy.
Secretary: Mr. Harold North, Queen's Hotel, Kandy.

A.A. of Bengal—
Headquarters: 1, Park Street, Calcutta.
Hon. Secretary: Mr. E. J. Oakley.

South Indian M.U.—
Hon. Secretaries: Mr. H. B. Pierce, Mount Road, Madras; Mr. G. V. Scovell, Bangalore; and Capt. Sturrock, R.A., Nilgiris.

M.U. of Western India—
Headquarters: 1, Esplanade Road, Fort, Bombay.
Hon. Secretary: Mr. N. M. Marshall.

Jamaica M.C.—
Hon. Secretary: Mr. H. H. Dunn, 31, Duke Street, Kingston.

Malta A.C.
Hon Secretary: Lieut. G. M. Morrell, R.E.

Auckland A.A.—
Headquarters: Vulcan Lane, Auckland, N.Z.
Hon. Secretary: Mr. A. Cleave, Vulcan Lane, Auckland.

Canterbury A.A.—
Headquarters: Gloucester Street, Christchurch, N.Z.
Secretary: Mr. E. Nordon.

Nelson A.A.
Hon Secretary: Mr. M. A. Jenny, Nelson, N.Z.

Selangor M.U.—
Headquarters: Kuala Lumpur, F.M S.
Hon. Secretary: Mr. D. A. Christie

Perak M.U.—
Headquarters: Ipoh, Perak, F.M.S.
Hon. Secretary: Mr. F. A. Harrison.

Singapore A.C.—
Hon. Secretary: The Hon. Evelyn C. Ellis, 10, Collyer Quay, Singapore, S.S.

A.C. of Algeria—
Headquarters: 23, Boulevard Carnot, Algiers
Secretary: Baron de Viviers.

A.C. of Argentina—
Headquarters: Calli Maipu 1,241, Buenos Ayres
Secretary: Senor J. Pacheco y Anchorena.

A.C. of Brazil—
Secretary: Senor Raul de Freitas Cressiuma, Praia de Botafogo 308, Rio de Janeiro.

A.C. of America—
Headquarters: 54th and 55th Streets, West of Broad way, New York City.
Secretary: Mr. Charles E. Forsdick.

American Motor League—
Headquarters: Vanderbilt Building, New York City
Secretary: Mr. Robert O. Brockway.

Royal A.C. of Belgium—
Headquarters: 17a, Avenue de la Toison d'Or, Brussels.
Secretaries: MM. P. d'Aoust and A. Michaut.

Antwerp A.C.—
Headquarters: 40-42, Grand Place, Antwerp.
Secretary: M. Th. Ratinckx.

A.C. of China—
Headquarters: Shanghai.
Hon. Secretary: Mr. E. Byrne, c/o Shanghai Waterworks Co., Ltd., Shanghai (*viâ* Siberia).

A.C. of Denmark—
Headquarters: Oestergade 26 (111), Copenhagen K.

A.C. of France—
Headquarters: 6, Place de la Concorde, Paris.
Secretary: M. Ch. Ward.

Imperial A.C. of Germany—
Headquarters: 9, Leipzigerplatz 16, Berlin W.
Secretary: Konter-Admiral a. D. Rampold.

Royal A.C. of Bavaria—
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R.A.C. Certified Trials of Accessories and Tyres.

During 1913 the Royal A.C. undertook a number of individual tests of accessories and cars. These trials are always interesting, and the official certificates of performance are well worth retaining for reference. Below will be found a summary of the reports issued of all the trials held in 1913, other than those of cars.

"Standard" Petroleum Carburetter and Vaporiser.

ENTERED by the Standard Petroleum Carburetter Patent Co., Ltd., Queen Victoria Street, London, E.C.

There were three separate trials, the first being a projected one of 3,000 miles (2,000 on the road, 1,000 on the track). Date of this first trial: October 21st to November 8th, 1912.

Paraffin is admitted, under gravity, through an orifice in which works an adjustable tapered needle. Air is drawn in through an automatic valve (fitted with a dashpot), which is connected through a rocking lever to the upper end of the tapered needle. The movement of the air valve, relative to that of this needle, can be adjusted by altering the position of the fulcrum upon which the rocking lever rests. The air, admitted by the valve, passes over the fuel orifice, and thence to a coiled tube (the vaporiser) situated within the silencer of the car. The mixture then passes through an asbestos-lagged pipe to the throttle of the engine. A hand-controlled extra air valve of the usual type is situated between the vaporiser and the engine throttle. The usual petrol carburetter is retained, a three-way cock determining from which source the engine draws its mixture.

Means were provided whereby water was allowed to drip on to two sets of gauze screens situated at each end of the vaporiser. Except on the first day and on one other occasion (on Sunrising Hill) these water drips were not used.

The weight of the whole device, including the combined vaporiser and silencer, petrol carburetter, and inlet pipe, was 67½ lbs.

The device was fitted to a 20.1 h.p. (R.A.C. rating) 1906 Darracq car, fitted with a governed engine.

The following are the particulars of the car: Bore and stroke of engine, 90×120 mm.; number of cylinders, four; weight, front axle 12 cwts. 0 qr. 17 lbs., back axle 10 cwts. 1 qr. 9 lbs.; total weight of car, 22½ cwts. approximately; average weight of load, 3 cwts. 0 qr. 11 lbs.; average running weight, 25½ cwts. approximately; gear ratio, on top gear 3.3 to 1, third gear 4.5 to 1, second gear 7.9 to 1, first gear 11.7 to 1, reverse gear 16.1 to 1; size of wheels, 875 mm.; engine revolutions on top gear at 20 m.p.h., 634 r.p.m.; wind area of body, 15 square feet; country of origin of device, Great Britain.

The cubical contents of the compression space of a cylinder of the engine were 262 c.c., and the contents of the volume swept by the piston were 763 c.c., giving a compression ratio of 3.91.

The paraffin oil used was an ordinary commercial burning oil, of which the following is the distillation test: 10 per cent. distilled at 166° C., 20 per cent. 177°, 30 per cent. 196° C., 40 per cent. 210° C., 50 per cent. 215° C., 60 per cent. 239° C., 70 per cent. 256° C., 80 per cent. 271° C., 90 per cent. 300° C.

During the trial the engine was started fifty-nine times, of which thirteen were after standing all night. Petrol was always used for starting, and the car was run upon that fuel until the change was made to paraffin by means of the three-way cock mentioned above. For this purpose 8.95 gallons of petrol were used. After the overnight stops the average time which elapsed before the change was made was 8m. 51s., the longest period being 11m. 47s., and the shortest 6m. 24s. In the case of the other forty-six starts the average time which elapsed before the change was made was 3m. 35s., the longest period being 7m. 56s., and the shortest 9s. These forty-six stops varied in duration from 2m. to 2h. 10m., the average length being 38m. On thirteen occasions experimental attempts were made to change to paraffin prior to doing so successfully.

The total distance run during the trial was 2,425.8 miles, being 2,000.5 upon the Club's six standard routes, and 425.3 upon the track.

The average speed (running time only) was 18.5 miles per hour. The paraffin used during this portion of the trial was 82.45 gallons, being a consumption of 24.32 miles per gallon, or 31.10 ton-miles per gallon.

1h. 10m. was spent in adjusting, cleaning, or examining the fuel needle and air valve, which were attended to on twelve occasions. On eight occasions the engine was turned over on to petrol to prevent stopping which appeared to be imminent, running thus for 3m. 43s.

On four occasions, when running light on paraffin, the engine stopped.

Twenty-two minutes were spent in repairing or adjusting the flexible wire control, which gave trouble upon three occasions. The paraffin filter was cleaned once, the time taken being 4¾m. Two sparking plugs were changed upon the road.

In addition to the above work, 11m. were spent in the motor house, cleaning and adjusting the fuel needle and air valve, which were attended to upon three occasions. One sparking plug was also changed.

The engine was run idle for 10m. on paraffin at an average speed of 685 revolutions per minute. This speed, which was fairly regular, was maintained by the engine governor. At the end of this period the throttle was opened somewhat slowly; the engine then accelerated very slowly with some misfiring, a dense volume of smoke being emitted from the exhaust pipe.

The car was driven on paraffin on top gear for 1.5 miles at an average speed of 11.8 miles per hour, the speed being controlled by the engine governor. The car was then accelerated to approximately 25 miles per hour in 1m. 10s. After attaining this speed there was no further increase for the next quarter of a mile. During this test neither the clutch nor brake was manipulated.

The following tests of consumption of paraffin were made:

Speed.	Consumption.	
Miles per hour.	Miles per gallon.	Ton-miles per gallon.
9.84 (on third gear)	19.90	25.78
14.88 (on top gear)	27.04	35.03
19.88 ,, ,,	27.94	36.20
24.89 ,, ,,	29.28	37.93
28.74 (maximum possible)	25.77	33.39

The car attempted to climb the test hill (average gradient, 1 in 5.027), but failed.

425.3 miles were covered upon the track at an average speed of 30.9 m.p.h. The paraffin consumed was 14.89 gallons, being a consumption of 28.5 m.p.g., or 36.99 ton-miles per gallon. At the conclusion of this distance the entrants withdrew from the trial, the reason given being the unsuitability of the car.

At the conclusion of the trial, the cylinders of the engine were removed. There was a moderate amount of deposit upon the pistons and cylinder heads. The valves had no deposit, but they and the sparking plugs were somewhat sooty. The joints at the ends of the rocking lever were somewhat worn, and the adjustable fulcrum was wobbly.

Owing to the nature and condition of the car used in the trial, it was hard to detect, definitely, misfiring, but three sparking plugs were changed (as mentioned above) for this suspected cause. The temperature of the cooling water was taken at intervals, and was found to vary between 62° C. (144° F.) and 88° C. (190° F.) The extra air supply referred to in the description above was used frequently. Prior to the engine being switched off, a change was always made to petrol for a few seconds. The car twice failed to climb Sunrising Hill in the usual manner. On both occasions the reverse was used, one passenger (176 lbs.) being dropped. During the trial the roads were heavy for approximately half of the distance, and rain fell on five days.

The Second Trial.

Date of trial: December 6th, 1912, to January 2nd, 1913. The device differed somewhat from that used in the first test. It weighed 53 lbs. 15 ozs., the weight of the petrol carburetter alone being 8 lbs. 14 ozs. It was fitted to a 53.6 h.p. R.A.C. rating Darracq car.

Bore and stroke of engine, 120 × 120 mm.; number of cylinders, six; weight, front axle 18 cwts. 0 qr. 9 lbs., back axle 18 cwts. 3 qrs. 2 lbs.; total weight of car, 36¾ cwts. approximately; average weight of load, 3 cwts. 0 qr. 17 lbs.; average running weight, 2 tons; gear ratio, on top gear 2.75 to 1, third gear 3.6 to 1, second gear 6.6 to 1, first gear 11.5 to 1; size of wheels, 880 mm.; engine revolutions on top gear at 20 m.p.h., 534 r.p.m.; country of origin of device, Great Britain. The cubical contents of

R.A.C. Certified Trials.

the compression space of a cylinder of the engine were 405 c.c., and the contents of the volume swept by the piston were 1,556 c.c., giving a compression ratio of 3.92.

Two kinds of paraffin were used. An ordinary commercial burning oil was used for the first 671 miles. The tank (still containing a few gallons of the first fuel) was then filled with the oil used for the remainder of the trial. The following are the results of distillation tests of the two fuels:

	First fuel.	Second fuel.
10 per cent. distilled at ...	158°C.	144°C.
20 " " "	172°C.	152°C.
30 " " "	187°C.	158°C.
40 " " "	201°C.	165°C.
50 " " "	214°C.	169°C.
60 " " "	230°C.	181°C.
70 " " "	248°C.	192°C.
80 " " "	264°C.	204°C.
90 " " "	287°C.	224°C.

During the trial the engine was started fifty-two times, of which eleven were after standing all night. Petrol was always used for starting, and the car was run upon that fuel until the change was made to paraffin by means of the three-way cock. After the overnight stops the average time which elapsed before the change was made was 5m. 40s., the longest period being 10m. 9s., and the shortest 3m. 4s.

In the case of the other forty-one starts, the average time which elapsed before the change was made was 3m. 7s., the longest period being 6m. 37s., and the shortest 1m. 20s. These stops varied in duration from 18m. to 1h. 10m., the average length being 38¾m.

On six occasions experimental attempts were made to change to paraffin prior to sucessfully doing so.

During the trial 22.34 gallons of petrol were used; 16.85 gallons of this were used for the first 836 miles, owing to the needle valve of the petrol carburetter leaking.

The total distance run during the trial was 2,000.5 miles, the trial being held upon the Club's six standard routes. The average speed (running time only) was 19.67 miles per hour. The paraffin used was 114.03 gallons, being a consumption of 17.58 miles per gallon, or 35.17 ton-miles per gallon.

There were eleven stops upon the road, of which five were caused by the petrol carburetter flooding. The remaining six stops occurred during the period (671 miles) when the first kind of fuel was being used. They were caused by testing for misfiring, cleaning four plugs, and replacing two plugs, the total time spent upon these being 1h. 13m. In addition to the above, one plug was cleaned in the motor house, and the stop limiting the travel of the three-way cock mentioned previously was adjusted.

At the conclusion of the trial, the cylinders of the engine were removed. There was a somewhat considerable amount of carbon deposit upon the pistons and cylinder heads, particularly those of No. 3 cylinder. The valves had no deposit, but they and the sparking plugs were somewhat sooty, two of the latter being cleaner than the others.

During the part of the trial when the first fuel was being used there was at intervals a considerable quantity of smoke emitted from the exhaust. When the first fuel was in use the car was unable to ascend Sunrising Hill until the three-way cock was so turned as to connect the engine with both the paraffin and petrol carburetters. Subsequently, when the second fuel was in use, the car ascended the hill without using the petrol carburetter. Owing to the performance of the car upon the road, and in view of the horse-power which from the engine dimensions should have been available, the Club made a maximum speed test upon Brooklands Track, when the speed attained was 34.22 miles per hour. The extra air supply referred to in the description was used with moderate frequency. Prior to the engine being switched off, the change was always made to petrol for a few seconds. The temperature of the cooling water was taken at intervals, and was found to vary between 62°C. (143° F.) and 79°C. (175° F.) Throughout the trial the roads were heavy, and rain fell on five days.

THE THIRD TRIAL.

This took the form of a traffic test, and it was made on January 14th, 1913. The weight of the whole device was 46 lbs. 14 ozs., the weight of the petrol carburetter being 4 lbs. 6 ozs. The car used was a 17.9 h.p. (R.A.C. rating) Darracq cab. The following are the particulars of the cab used.

Bore and stroke of engine, 85 × 105 mm.; number of cylinder, four; weight, front axle 13 cwts. o qr. 2 lbs., back axle 14 cwt. 2 qrs. 9 lbs.; total weight of car, 27½ cwts. approximately; weight of load, 5 cwts. 0 qr. 1 lb.; total running weight, 32½ cwts. approximately; gear ratio on top gear, 4.875; size of wheels, 810 mm., engine revolutions on top gear at 20 m.p.h., 1,030 r.p.m. The cubical contents of the compression space of a cylinder of the engine were 224 c.c., and the contents of the volume swept by the piston were 595 c.c., giving a compression ratio of 3.66.

The paraffin oil used was marketed by Messrs. Carless, Capel, and Leonard as Phœbus oil. A sample of the fuel used was subjected to a distillation test, and the following is the result of the test, and also of one of ordinary commercial burning oil:

	Phœbus.	Ordinary.
10 per cent. distilled at ...	142° C.	152° C.
20 " " "	148° C.	164° C.
30 " " "	154° C	181° C.
40 " " "	162° C.	198° C.
50 " " "	170° C.	209° C.
60 " " "	177° C.	229° C.
70 " " "	189° C.	243° C.
80 " " "	203° C.	261° C.
90 " " "	224° C.	280° C.

The route followed during the trial was between Russell Court (St. James's) and Bow Bridge, E., *viâ* Pall Mall, Cockspur Street, Trafalgar Square, Strand, Fleet Street, Ludgate Hill, St. Paul's Churchyard, Cannon Street, Queen Victoria Street, Mansion House, Lombard Street, Fenchurch Street, Aldgate, Whitechapel Road, and Mile End Road.

The length of the double journey was 11.6 miles, which was covered six times, making a total distance of 69.7 miles. The trial started at 8.38 a.m. and ended at 6.10 p.m. There were voluntary stops for lunch, etc., totalling 1h. 41m., during which the engine was stopped, and in addition 108 traffic stops, ranging in length from 1s. to 1m. 40s. The time occupied by these latter stops was 35m. 42s., during which the engine was kept running.

The average speed (running time only) was 9.61 miles per hour.

The quantity of paraffin used was 4.35 gallons, being a consumption of 16.02 miles per gallon, or 26.12 ton-miles per gallon.

There was no misfiring throughout the trial, which was completed without incident. The weather was damp and the roads were greasy.

Atlas Puncture-proof Tyre.

Entered by the Atlas Non-puncture Inner Case Syndicate, Ltd., 124, High Street, Kensington, W. The trial took place on January 23rd, 1913.

The tyres, which were 815×105 mm., all rubber tread, were fitted to a 20.1 h.p. (R.A.C. rating) Bianchi car, the engine dimensions of which were 90 × 115 mm. (four-cylinder). The weight of the car was 25½ cwts. approximately (front axle 11 cwts. 3 qrs. 22 lbs., back axle 13 cwts. 2 qrs. 3 lbs.). The load carried was 3 cwts. 17 lbs., making a total running weight of 28 cwts. approximately. The wind area of the car was 14.7 square feet. The tyres were inflated to the following pressures: Near front 77 lbs. per square inch, off front 75 lbs. per square inch, near back 67 lbs. per square inch, off back 69 lbs. per square inch.

A distance of 202.8 miles was run without stopping on Brooklands track at an average speed of 43.76 m.p.h. At the end of this distance the temperature of the wall of the near back tyre was 36° C. (97° F.), that of the outside air being 11½° C. (53° F.).

Two ⅞in. deal boards, 6ft. 2in. long × 11¾in. wide, were provided. 2in. wire nails were driven through so as to project about 1⅛in. These nails were so spaced as to be approximately 1⅞in. from one another. The boards were placed upon the track, and the car driven steadily over them five times, in the following manner: (1.) Along the boards lengthways. (2.) Along the boards lengthways (over same track). (3.) Along the boards lengthways (over different track). (4 and 5.) Across the boards. After the test the nails were found to be bent, and in many cases partially driven back through the boards. The tyres were not punctured, and after standing all night were still at approximately the same pressure.

Atlas Impulse Tyre Pump.

Entered by the Atlas Non-puncture Inner Case Syndicate, Ltd., 124, High Street, Kensington, London, W. The trial took place on March 25th, 1913.

The device, which is permanently screwed into a valve cap of the engine, consists of two different size cylinders in tandem, from the smaller of which the air is forced through a non-return valve to the tyre. These cylinders are divided by a partition through which passes a hollow piston rod connecting the larger and smaller pistons. The

lower end of this rod is closed by a non-return valve, while the upper end communicates with the smaller cylinder on the engine side of its piston. The larger piston is of the usual type with two rings, while the smaller is a leather cup. A suction valve allows air to be drawn into the engine on its down stroke, while to permit the displacement of the larger piston holes are provided close to the dividing partition already mentioned. The diameters of the two pistons are respectively 2¼in. and 1½in. The weight of the device as entered, with gauge and 12ft. of tubing (but not including the screw valve by which the pump was attached to the engine valve cap), was 6 lbs. 6 ozs. The overall length of the device (not including the connection to the engine valve cap) was 10½in.

The device was tested on a 20.1 h.p. (R.A.C. rating) Bianchi car, the dimensions of the cylinders of which were 90 mm. × 115 mm. The pump was fitted as a permanent attachment, lying transversely across the top of the front cylinder of the engine. The pump was connected to the engine valve cap through a screw-down valve, by turning which it was put into operation. The tyres used in the tests were 815 mm. × 105 mm.

The device was put into operation (without using a tool) twice, the times taken being 32s. and 28s. respectively, after **the bonnet had been lifted. Two tyres were inflated to a** pressure of 66 lbs. per square inch in 2m. 50s. and 3m. 21s. respectively, with the engine running at 640 revolutions per minute; the wheels of the car were jacked up during inflation. When the air passing from the tubing had been allowed to impinge from a distance of 1in. upon a piece of white **blotting paper for 3¼m.** (*i.e.*, **about the time taken to inflate** one tyre), a slight mark of oil was just visible. This test was made 12½m. after the two tyres had been inflated. **During this test the engine was running at 688 revolutions** per minute, but the pump did not seem to be working at **its full stroke, which appeared to be caused by the fact that** it was not doing any work. When the pump was in operation the engine cylinder was not firing, although no electrical connections were broken.

Favourite Carburetter.

Entered by the Favourite Carburetter, Ltd., 14, Caxton House, Westminster, S.W. **The trial took place on April 15th, 1913.**

The carburetter is of the usual form, with float chamber and mixing chamber. There are two sources of fuel supply to the engine: *(a)* The usual central jet (which is adjustable **by a taper needle); and** *(b)* **a bypass entering the induction** pipe at the point at which the lip of the butterfly throttle **touches. Provision is made whereby an air valve is opened progressively as the throttle is opened. In addition, air is** admitted to the engine through the throttle spindle when the throttle is completely closed and the engine is not firing.

The carburetter was fitted to a 28-35 h.p. (22.4 R.A.C. rating) Benz car. The carburetter was warmed by the engine-cooling water. The particulars of the car were as follow: Engine (four cylinders), 95 mm. × 140 mm.; volume of the compression space of a cylinder, 293 c.c.; volume swept by the piston, 991 c.c.; compression ratio, 4.3; weight of car, 3,770 lbs. (33¾ cwts. approx.); weight of car and load as run 4,495 lbs. (40 cwts. approx.); gear ratio on top gear, 3.25 to 1; size of wheels, 880 mm.; wind area of body, 14.0 square feet; country of origin of car, Germany.

The weather was fine and roads good. The route traversed was London, Ewell, Reigate, Westerham, Crawley, Horsham, Weybridge, the distance being 106 miles. On two occasions **the engine was stopped accidentally, once when letting in** the clutch and once when starting on a hill after having come to rest when changing to first speed. The average **speed throughout the trial (running time only) was 19.3** m.p.h.; the fuel consumed (benzole) was 3.87 gallons, being a **consumption of 27.38 m.p.g. or 54.94 ton-miles per gallon.** The following is the result of the distillation test of the **benzole used:**

First drop distilled at	75° C.
10 per cent. ,, ...	84.5° C.
20 ,, ,, ...	85° C.
30 ,, ,, ...	86° C.
40 ,, ,, ...	87° C.
50 ,, ,, ...	88° C.
60 ,, ,, ...	89° C.
70 ,, ,, ...	91.5° C.
80 ,, ,, ...	94.5° C.
90 ,, ,, ...	103.5° C.

The specific gravity of the fuel, which was 0.873 at 15.5° C., may indicate the presence of an extremely small quantity of petrol, so small as probably to be caused by imperfect draining of the tanks and pipes prior to the filling up with the benzole.

Previous to the foregoing road trial a series of tests was made with benzole and petrol respectively on Brooklands **track. These took place from April 7th to 12th, 1913.**

After tests 1 to 7 the carburetter was adjusted and the valves of the engine ground in. No adjustment or alteration **was made between the tests in which benzole was used and those in which petrol was used.**

One method of negotiating a corner at speed. A Vauxhall car skidding round a corner in the Caerphilly (South Wales) hill-climb. Last year witnessed quite a revival of the interest taken in hill-climbing contests.

R.A.C. Certified Trials.

SUMMARY OF TESTS.—FAVOURITE CARBURETTER.

No. of test.	Fuel used.	Speed, m.p.h.	Consumption. m.p.g.	ton miles per gal.
1	Benzole	13.17	19.5	36.4
2	,,	18.85	19.5	36.4
3	,,	25.99	18.77	35.05
4	,,	31.41	17.55	32.75
5	,,	38.45	17.55	32.75
6	,,	44.02	17.55	32.75
7	,,	48.79 (maximum)	15.59	29.09
(The carburetter was then adjusted.)				
8	Benzole	13.35	33.40	62.34
9	,,	19.31	30.44	56.82
10	,,	25.10	28.63	53.44
11	,,	31.12	26.52	49.51
12	,,	37.17	21.67	40.44
(Higher speeds were not attempted by the entrant.)				
13	Petrol	13.53	26.57	49.60
14	,,	19.21	25.30	47.22
15	,,	25.21	23.93	44.67
16	,,	32.01	22.36	41.74
17	,,	36.45	20.68	38.60
(Higher speeds were not attempted by the entrant.)				

Note.—The speeds are average speeds, but were kept as constant as possible during each test.

"Standard" Petroleum Carburetter and Vaporiser.

Entered for 1,000 miles road trial by the Standard Petroleum Carburetter (Parent) Co., Ltd., 171, Queen Victoria Street, London, E.C. Date of trial: April 29th to May 6th, 1913.

Paraffin is admitted under gravity to a float chamber of the usual form situated to the rear of the silencer of the car. The fuel passes to a jet, immediately above which is an orifice with an adjustable shutter for the admission of air. A tube leaving the jet chamber takes the paraffin-charged air to the vaporiser situated in front of the silencer. The vaporiser consists of a coil of tube in a chamber to which the exhaust is admitted. Between the throttle and the vaporiser is an automatic air valve, the strength of the spring of which is controlled by the driver. The mixture is then taken through a throttle to a three-way cock, which communicates with the engine and also with an ordinary petrol carburetter, the throttle of which is linked up with that of the paraffin carburetter. The three-way cock determines from which source the engine draws its mixture.

The weight of the whole device, including vaporiser, was 35 lbs. 11 ozs., and was fitted to a 20 h.p. (22.4 R.A.C. rating) Ford car.

Bore and stroke of engine, 95 mm. × 102 mm.; number of cylinders, four; weight, front axle 6 cwt. 3 qrs. 22 lbs., back axle 8 cwt. 2 qrs. 1 lb.; total weight, 15½ cwt. approximately; average weight of load, 3 cwt. 0 qr. 6 lbs.; average running weight, 18½ cwt. approximately; gear ratio on top gear, 3.63 to 1; size of wheels, 760 mm.; engine revolutions on top gear at 20 m.p.h., 816 r.p.m.; country of origin of device, England.

The cubical content of the compression space of a cylinder of the engine was 261 c.c., and the volume swept by the piston was 723 c.c., giving a compression ratio of 3.8.

The paraffin oil used was subjected to a distillation test, and the following is the result of the test, and also of one of ordinary commercial burning oil.

	Fuel used.	Ordinary paraffin oil.
10% distilled over at	144°C.	152°C.
20% ,, ,,	153°C.	164°C.
30% ,, ,,	160°C.	181°C.
40% ,, ,,	167°C.	198°C.
50% ,, ,,	172°C.	209°C.
60% ,, ,,	180°C.	229°C.
70% ,, ,,	190°C.	243°C.
80% ,, ,,	204°C.	261°C.
90% ,, ,,	224°C.	280°C.

The trial was held upon the Club's six standard routes, the total distance traversed being 1,000 miles, which was covered at an average speed (running time only) of 19.91 m.p.h. The weather was fine, and the roads in good condition. During the trial the engine was started thirty-five times, of which six were after standing overnight. On ten occasions, after short stops (longest seven minutes), the engine was started on paraffin; at other times the petrol carburetter was used for starting. The average time elapsing after starting until the fuel was changed over to paraffin was 2m. 29s. The longest wait was 4m. 56s., which was after standing all night. On seven occasions experimental attempts were made to change to paraffin prior to doing so successfully. The engine was stopped accidentally once when changing gear. It was found that the three-way cock mentioned in the description had moved, putting the engine partly into communication with the petrol carburetter, from which the petrol had been turned off. On two other occasions the engine was accidentally stopped when starting or stopping the car. No work was done upon the carburetter, or upon the engine during the trial. The temperature of the cooling water was taken at intervals, and was found to vary between 91°C. (196°F.) and 93°C. (200°F.).

The amount of paraffin used was 30.28 gallons, being a consumption of 33.03 miles per gallon or 35.69 ton miles per gallon; 1.69 gallons of petrol were used for starting purposes.

At the conclusion of the trial the cylinders of the engine were removed. There was a somewhat considerable amount of deposit upon the pistons and cylinder heads.

Morris Paraffin Carburetter.

Entered by the Stewart Precision Carburetter Co., Ltd., 299, Piccadilly, London, W., for a non-stop run from London to York and back. Date of trial: May 23rd and 24th, 1913.

The weight of the carburetter and vaporiser was 18 lbs. 14 oz., of which the vaporiser weighed 12 lbs. 3 oz. The dimensions of the vaporiser were 8¾in. × 4½in. × 4in.

The following are the particulars of the Belsize car used: Weight, front axle 8 cwt. 3 qrs., back axle 10 cwt. 3 qrs. 8 lbs.; total weight, 19 cwt. 2 qrs. 8 lbs.; average weight of load during trial, 3 cwt. 1 qr. 14 lbs.; average running weight during trial, 22 cwt. 3 qrs. 22 lbs.; bore and stroke of engine, 69 mm. × 130 mm.; number of cylinders, four; gear ratio on top gear, 4.58 to 1; approximate engine revolutions on top gear at 20 m.p.h., 971; size of tyres, 810 mm.

The cubical capacity of the compression space of a cylinder of the engine was 130 c.c., and the cubical capacity of the volume swept by the piston was 486 c.c., giving a compression ratio of 4.3.

The paraffin and the petrol used for starting were fed under pressure to the carburetter, which was fitted in the usual place.

The total distance covered was 395 miles, which was run at an average speed (running time only) of 20.0 m.p.h. The engine was momentarily stopped once upon declutching at 128 miles. With this exception it ran continuously through out the trial for 20h. 22m. 30s., during a total of 37m. 12s. of which time the car was stationary. The engine ran upon paraffin, except when being started, and for 17m. during one car stop (the longest) when the paraffin tank was being refilled at York. Petrol was then used, as the entrants had made no arrangements for running the engine upon paraffin while the paraffin tank was being refilled.

The paraffin consumed was 12.87 gallons, being a consumption of 30.69 m.p.g., or 35.21 ton-miles per gallon.

Lubricating oil was put into the engine at 114 miles, and again at York 197½ miles. The radiator was filled at York and again at ninety-two miles from London. During the trial, the pressure system leaked continuously and the pressure had to be maintained by hand. The pressure was kept between 5 and 6 lb. per square inch. At the time of the engine stop mentioned above, the pressure was 5½ lb. per square inch.

The fuel was changed to paraffin three and a half minutes after starting at the commencement of the trial. After the engine stop it was started upon paraffin. During the trial the hand-controlled air valve was in constant use. The sparking plugs were examined after the trial and found to be clean.

Zip Puncture Sealer.

Entered by the Zip Agency, 2, Ormond Yard, York Street, Jermyn Street, London, S.W. Date of trial: June 5th and 6th, 1913.

The material, a greyish powder, was mixed with warm water in the proportion of 6½ ounces to 21 fluid ounces of water. This quantity of mixture was injected, through the valve, with a special syringe, into each tyre. Four tyres (810 mm. × 90 mm.) were treated, the tubes being new and sealed as received from the makers. The compound was injected (after the tyres had been fitted to the wheels) in an average time of 44s. per tyre. The valves of the tyres were then cleaned. After being treated and inflated the tyres were punctured in three places—twice with a 3 mm. bradawl and once with a wire nail of the same diameter. The wire nails were left buried in the tread of the covers. The wheels of the car were jacked up prior to puncturing the tyres, and immediately after the puncturing the wheels were spun. After standing all night the car was run upon the road, two of the tyres being re-inflated.

The following table gives details of the test:

PRESSURE IN LBS. PER SQUARE INCH.

Tyre No.	Before puncturing.	After puncturing.	After standing approx. 16 hours.	Re-inflated to	After running 51 miles.*
1	Not taken	60	16	57	53
2	62	61	59	—	55
3	60	59	26	60	58
4	57	57	57	—	55

* These pressures were taken 1½ hours after the car had completed the distance.

"Herroline" Motor Fuel Energiser.

Entered by Messrs. J. B. Foote and Co., 146, Fenchurch Street, London, E.C. Date of trial: June 19th and 20th, 1913.

A quantity of standard commercial petrol was divided into two parts, and to one part was added Herroline in the proportion of 3 ozs. to 5 galls. of petrol.

Distillation tests of the two samples of fuel, treated and untreated, were made, and the following are the results:

	Treated.	Untreated.
Distillation commenced at	47° C.	47° C.
10% distilled below	79° C.	78° C.
20% ,, ,,	83° C.	83° C.
30% ,, ,,	88° C.	91° C.
40% ,, ,,	95° C.	95° C.
50% ,, ,,	98° C.	98° C.
60% ,, ,,	105° C.	105° C.
70% ,, ,,	110° C.	110 °C.
80% ,, ,,	118° C.	117° C.
90% ,, ,,	130° C.	131° C.
100% ,, ,,	174° C.	178° C.
Specific gravity at 15.5° C.	0.724	0.722

Comparative fuel consumption tests were made with the treated and with the untreated fuel, no carburetter adjustment being made between the tests.

The car used was a 30 h.p. (34.5 R.A.C. rating) 1907 Siddeley, fitted with a landaulet body. The engine dimensions were 118 mm. × 127 mm. The running weight of the car with passengers was 4,338 lbs. (38¾ cwt. approx.). The following are the results of the tests:

UNTREATED PETROL.

No. of test.	Nominal speed.	Actual speed.	Consumption. Miles per gal.	Ton-miles per gal.
1	15 m.p.h.	15.2 m.p.h.	19.58	37.90
2	20 m.p.h.	20.0 m.p.h.	22.94	44.41
3	25 m.p.h.	24.7 m.p.h.	23.31	45.13
4	All out	28.7 m.p.h.	23.36	45.23

TREATED PETROL.

No. of test.	Nominal speed.	Actual speed.	Consumption. Miles per gal.	Ton-miles per gal.
5	15 m.p.h.	15.2 m.p.h.	20.01	38.73
6	20 m.p.h.	20.0 m.p.h.	23.44	45.37
7	25 m.p.h.	24.4 m.p.h.	24.06	46.59
8	All out	28.2 m.p.h.	23.36	45.23

There was some rain during tests Nos. 1, 2, and 5, and a gentle breeze during the first four tests, which died away. Temperature: Max. 67° F., min. 52° F.

Smith Four-jet Carburetter.

Entered by Messrs. S. Smith and Son, Ltd., 179, Great Portland Street, W., for a fuel consumption test. Date of trial: August 21st, 1913.

The carburetter was fitted in the usual place to a 15.6 (R.A.C. rating) Crossley car, of which the following are particulars: Bore and stroke of engine, 79 × 120 mm.; number of cylinders, four; weight of car, front axle 11 cwts. 2 qrs. 19 lbs., back axle 14 cwts. 0 qrs. 14 lbs.; total weight of car 25¾ cwts. (approx.); weight of load, 5 cwts. 3 qrs. 4 lbs.; total running weight, 31½ cwts. (approx.); wind resistance area of body, 13.5 square feet; gear ratio on top gear, 4.16 to 1; size of tyres, 820 × 120 mm.; engine revolutions at 20 m.p.h., 866.3 r.p.m.; country of origin of carburetter, Great Britain; weather, fine, warm.

The trial was held upon Brooklands track, ordinary commercial motor spirit being used. The speeds given are average speeds, but were kept as constant as possible during each test.

SUMMARY OF TEST.

No. of test	Speed, m.p.h.	Miles per gal.	Ton-miles per gal.
1.	20.6	36.61	57.81
2.	29.9	30.09	47.51
3.	39.0	24.44	38.59

Higher speeds were not attempted by the entrant.

Puncture Seal.

Entered by Messrs. Puncture Seal Ltd., the Motor House, Eden Street, Euston Road, London, N.W. Date of trial, July 21st to 26th, 1913.

The substance consists of a black viscous material having the appearance of semi-solid rubber. It is injected through the valves of the tyres by means of a steam-jacketed force pump. The holes in the body of the valve are enlarged in order to allow a freer passage for the material, which, after being injected, is distributed throughout the tube with a roller.

Four 815 mm. × 105 mm. inner tubes of standard pattern were treated, the average time taken per tube being sixteen and a half minutes. The average weight of material injected into each tyre was 4 lbs. 6 oz. The valves were then cleaned and the tyres fitted to the wheels. The car used weighed 27¾ cwts. (approximately) loaded.

After fitting, the tyres were run twenty-two miles at the entrant's wish. They were then punctured by driving into each tyre, radially to the section of the tyre, twelve 3 mm. × 50 mm. wire nails, which were left in buried to the head. In the case of the off rear tyre the nails were driven in on alternate sides of the centre line of the tread and one inch from it—*i.e.*, on the edge of the tread. In the case of the other tyres the nails were inserted along the centre of the tread. In every case the nails were approximately equally spaced out round the circumference of the tyre. The car was then driven upon the road, and after twenty-six miles had been covered and the car had stood overnight each tyre was further punctured in three places early during the second day's run by a 3½ mm. bradawl. On the third day, after a few miles had been covered, the car was driven at a speed of about 15 m.p.h. once over two boards (one for each side of the car) five and a half feet long, in which were upstanding wire nails, spaced two inches apart and projecting approximately one inch. At the end of the third day's run a total distance of 363 miles had been covered. The pressures were recorded after the tyres had stood for two days and three nights.

Pressures in lbs. per square inch.

Tyre.	Initial pressure.	Fall in pressure after nail punctures.	Pressure at end of trial.	Loss of pressure during trial.
Off front	66	nil	62	4
Near front	71	3	61	10
Off near	70	nil	nil	(See notes)
Near rear	69	nil	64	5

The initial pressure in the case of the near front tyre was measured forty-five minutes before puncturing the tyre, and not immediately before as in the case of the other three tyres. During the trial the valves of the tyres were tested and found not to leak.

Before the start of the third day's run, the pressure in the off rear tyre having fallen during the night to 37 lbs. per sq. in., the tyre was re-inflated to 70 lbs. per sq. in. At the end of that day—*i.e.*, at the end of the road trial—the pressure, taken when the tyre was warm, was 43 lbs. per sq. in. It should be noted that it was this tyre which had the nails driven in along the edge of the tread. The trial was run at an average speed (running time only) of 18.6 m.p.h.

After the trial the off rear tyre was removed for examination. A very small quantity of the material had exuded from the tube at each puncture. There were no traces of water having entered the tyre through the punctures, although rain was encountered during the trial.

Gautier Metallic Fabric Tyre.

Entered by the Gautier Metallic Fabric Tyre Syndicate, Ltd., 27a, Bangalore Street, Putney, London, S.W., for a 6,000 miles trial. Date of trial: July 21st to September 24th, 1913.

The tyres were pneumatic tyres of the usual form, except that, instead of canvas, the carcase of the outer cover was formed of one diagonal layer of small chains of the type consisting of flat side-plates joined by transverse rivets. The distance between the rivet centres was 10 mm., while the width of the chain was 4.5 mm. Each chain ended in wire hooks, which passed into the bead of the tyre. The tyre was lined with four layers of canvas, and had the usual rubber tread on a canvas support. The tyres, which were made in Great Britain, were 880 mm. × 120 mm., and the average weight of each was 54 lbs. All tyres were inflated, initially, to a pressure of 75 lbs. per square inch, but during the trial the pressure was varied between that and 85 lbs. per square inch. The tyres were fitted to a 38.8 h.p. (R.A.C rating) four-seated (1906) Bianchi car. The weight of the car was 3,598 lbs. (35 cwt. approx.), the weight on the front

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axle being 1,571 lbs. and on the back 2,023 lbs. The average running weight, with passengers, during the first 2,100 miles of the trial was 4,072 lbs. (36½ cwt. approx.). For the remainder of the trial the running weight was 4,016 lbs. (35¾ cwt. approx.). At the end of a total distance of 5,163 miles the only tyre still running was put on to a 20.1 h.p. (R.A.C. rating) Schneider car with four-seated closed body loaded so as to have the same running weight as the Bianchi.

The trial was held on the road of the Club's six standard routes. The average speed throughout the trial was 19.69 m.p.h. Below is given a table, showing the mileage of each tyre and details of its performance.

	Front wheel.	Back wheel.	Miles run.
No. 1	938	1,149	2,087
No. 2.	2,824	1,782	4,606
No. 3.	3,212	2,289	5,501
No. 4.	1,832	1,306	3,138

After 336 miles had been covered the car was accidentally driven off the road so that the two wheels on the near side (tyres Nos. 1 and 4) bumped over three grips (drainage channels) at the side of the road. These grips were about six inches deep and twelve inches wide, and the back spring shackle of the near rear spring was inverted. At 2,942 miles the off-front spring was found to be broken and was replaced. The near front spring broke at 4,116 miles, and the near side member of the frame was found to be cracked at 3,820 miles.

The following are details of the performance of each tyre:

TYRE No. 1.

767 miles. One cut plugged.
2,087 ,, Deflated on road. Withdrawn.

TYRE No. 2.

767 miles. One cut plugged.
2,102 ,, Removed and examined.
2,345 ,, Lined tyre with two strips of canvas.
2,891 miles. Deflated on road. Two canvas patches fitted inside.
3,894 ,, Replaced 18in. of canvas strips with three layers of canvas and four patches.
4,259 ,, Deflated on road. Canvas going in five places. Four (36in. altogether) patches put in.
4,606 ,, Deflated on road and withdrawn.

TYRE No. 3.

767 miles. One cut plugged.
1,603 ,, One cut plugged.
2,101 ,, Removed and examined.
2,345 ,, Removed and examined.
2,942 ,, Two tread cuts repaired.
3,582 ,, Removed and examined.
4,113 ,, Two cuts repaired. Eight inches of loose tread cold vulcanised. Two canvas patches put inside.
4,391 ,, One cut repaired; replaced one canvas patch with new one.
4,879 ,, Deflated on road. One canvas patch put in.
5,307 ,, Four patches put in.
5,501 ,, Deflated on road and withdrawn.

TYRE No. 4.

767 miles. One cut solutioned up.
2,102 ,, Removed and examined.
2,310 ,, Deflated on road. Two canvas patches in.
3,006 ,, Replaced two patches by new ones, and put in two more patches.
3,138 ,, Deflated on road and withdrawn.

The canvas patches referred to in the above details were needed in every case by the lining of the cover cracking along the diagonal line of the chains. The air tube then got into the crevice thus formed, and the tyre deflated. After the trial the canvas in each tyre was found to be giving way in many places, and in one of the tyres the tread was found to be loose in places.

"Economin" Fuel.

Entered by the Economin Syndicate, Ltd., 6, Old Jewry, London, E.C. Date of trial: September 11th to 29th, 1913.

The certificate of performance, after giving the results of distillation tests of the three casks of fuel submitted, two of which (used in the road trials) were of specific gravity of .766 and the third .760 at 15.5 C., continues:

The trial was divided into three parts: (1.) 1,000 miles upon the road on "Economin." (2.) 1,000 miles upon the road on ordinary motor spirit (No. 1 Shell). (3.) Comparative tests at Brooklands.

The car used in each case was a 15 h.p. (18.8 R.A.C. rating) 1911 Straker-Squire, the engine dimensions of which were 87 mm. by 120 mm. The weight of the car was 2,552 lbs. (22¾ cwt. approx.), the running weight (with load) being 2,855 lbs. (25½ cwt. approx.)

The trial was held upon the Club's standard routes, and the conditions for each 1,000 miles were similar, except that the weather was somewhat finer.

The lubricating oil used in the engine was measured during each of the 1,000 mile tests, and was found to be 2.9 gallons and 3.8 gallons with Economin and No. 1 Shell.

At the conclusion of each road test the engine was dismantled and examined, and the carbon deposit upon the cylinder head removed and weighed. In both cases there was practically no deposit except in the case of two of the piston heads which had a very small amount, and which showed signs of excessive lubrication. All the valves and plugs were somewhat sooty in both tests. After both tests it was found that two of the exhaust valves had not been seating properly.

At the conclusion of the road tests comparative tests with the two fuels (without intermediate carburetter adjustment) were made on Brooklands track.

The following are the results of the tests:

Fuel.	Flying half-mile. m.p.h.	Speed up test hill. m.p.h.
Economin	48.77	10.83
No. 1 Shell	48.49	10.56

No carburetter or other adjustment was made between the tests.

The following table shows the results of the road tests:

Fuel used.	Miles run.	Average speed (Running time only.)	Amount of fuel consumed.	Consumption. m.p.g.	Ton-m.p.g.	Weight of carbon deposit.
Economin	1,000,375	19.9 m.p.h.	44.54 gals.	22.53	28.72	32.4 grs.
No. 1 Shell	1,000,375	19.7 m.p.h.	44.86 gals.	22.38	28.52	53.4 grs

"Jut Put" Motor Fuel.

Entered by Mr. Charles Edward Courtenay Luck, "The Cottage," Dartford, Kent. Date of trial: October 9th, 1913.

Distillation tests of a sample of the fuel and of ordinary spirit used was made as follow:

	"Jut Put."	Ordinary motor spirit.
Distillation commenced at	74°C.	52°C.
10% distilled below...	101°C.	82°C.
20% ,, ,,	112°C.	91°C.
30% ,, ,,	129°C.	98°C.
40% ,, ,,	144°C.	103°C.
50% ,, ,,	153°C.	108°C.
60% ,, ,,	161°C.	113°C.
70% ,, ,,	168°C.	121°C.
80% ,, ,,	178°C.	131°C.
90% ,, ,,	191°C.	149°C.
100% ,, ,,	219°C.	174°C.
Specific gravity at 15.5°C....	0.807	0.742

Comparative consumption tests were made with "Jut Put" and with motor spirit, no carburetter adjustment being made between the tests.

The car used was a 15.9 h.p. Arrol-Johnston, the engine dimensions of which were 80 mm. × 120 mm.

The running weight of the car was, with passengers, 2,860 lbs. (25½ cwt. approx.).

The results of the tests on Brooklands were:

"JUT PUT."

No of test	Nominal speed.	Actual speed.	Consumption. Miles per gal.	Ton-miles per gal.
1	15 m.p.h.	14.9 m.p.h.	29.25	50.40
3	20 m.p.h.	20.0 m.p.h.	28.77	49.58
5	25 m.p.h.	25.2 m.p.h.	26.59	36.00
7	30 m.p.h.	30.2 m.p.h.	25.81	44.47
9	35 m.p.h.	35.2 m.p.h.	22.79	39.28
11	All out	40.3 m.p.h.	—	—

ORDINARY MOTOR SPIRIT.

No of test.	Nominal speed.	Actual speed.	Consumption. Miles per gal.	Ton-miles per gal.
2	15 m.p.h.	15.0 m.p.h.	27.85	48.00
4	20 m.p.h.	20.2 m.p.h.	27.85	48.00
6	25 m.p.h.	25.1 m.p.h.	27.42	47.25
8	30 m.p.h.	30.3 m.p.h.	24.72	42.59
10	35 m.p.h.	35.1 m.p.h.	22.21	38.28
12	All out	40.6 m.p.h.	—	—

The above are average speeds, but were kept as constant as possible during each test. The weather was fine, warm at first, and cold later. Temperature, max. 59°F., min. 52°F. The engine started without difficulty.

Atlas Empty Quick.

Entered by the Atlas Non-puncture Inner Case Syndicate, Ltd., 14, Woodstock Street, London, W. Date of trial: October 11th, 1913.

The device consists of a straight brass tubular spout, which is attached to a petrol can by pushing two spring arms through the orifice of the can. A sleeve which telescopes over the spout is then pushed up by a flange on its upper end, the flange resting on the rim of the car tank filler, thus exposing the outlet of the spout. Filter gauze is provided at the end of the spout. The weight of the device is 11 ozs., the overall dimensions being 9in. × $2\frac{3}{4}$in.

Two standard fuel cans were used for the te.ts, one with a small (1in. orifice and the other with a larger ($1\frac{1}{4}$in.) orifice. Two gallons of petrol were measured into the cans before each test. The following table shows the results of the tests:

Test.	Poured out of	Poured into	Time of attachment of device. Sec	Time taken in emptying can. Min. Sec.	Time of detachment of device. Sec.
1.	Large orifice can ...	tank	$2\frac{4}{5}$	1 6	$\frac{4}{5}$
2.	Small orifice can ...	tank	$14\frac{3}{5}$	2 $12\frac{1}{5}$	$6\frac{1}{5}$
3.	Large orifice can ...	open receptacle	$3\frac{1}{5}$	1 $22\frac{2}{5}$	$\frac{3}{5}$
4.	Small orifice can ...	open receptacle	$11\frac{2}{5}$	2 $18\frac{4}{5}$	$6\frac{4}{5}$

In every test the can was completely emptied. In test No. 2 a small amount of petrol was spilled in inserting the device into the opening of the tank. No petrol leaked out when the can was inverted if the fuel was flowing through the spout at the time, but between $1\frac{1}{2}$ oz. and 2 oz. was lost in each test when the can was held inverted for 16s. with outlet of device closed.

The large and small aperture cans were emptied in $42\frac{2}{5}$s. and 1m. 10s. respectively when the device was not attached.

Zip Puncture Sealer.

Entered by Messrs. H. M. Hobson, Ltd., 9, Grafton Street, Bond Street, London, W. Date of trial: October 14th, 15th, and 16th, 1913.

The material was a greyish powder, which was mixed with cold water in the proportion of 10 oz. to 25 oz. of water. This quantity of mixture was injected, through the valve, into each air tube with a special syringe. Four tyres (815 mm. × 105 mm.) were treated, the tubes being new and as received from the manufacturers. The compound was injected in an average time of 1m. 22s. per tyre. After the tyres were treated and inflated, the car, weighing 3,625 lbs. loaded ($32\frac{1}{4}$ cwt. approx.), was driven for twenty-three miles before the tyres were intentionally punctured. On returning from this run it was found that the near front tyre was leaking, and subsequent examination showed that the tube was defective, there being a small slit on the side nearest the rim. This slit was approximately 2 mm. long. The tube was replaced by a new one, which was treated.

The tyres were then punctured by driving into each, radially to the section of the tyre, three 3 mm. × 50 mm. wire nails, which were then withdrawn by the entrant. The nails were driven in in each case at equidistant points on the circumference, two being in the centre line of the tread and the third 1in. outside the centre line.

The tyres were under observation for $50\frac{1}{2}$ hours after being punctured. Of this time the car stood for $34\frac{3}{4}$ hours and ran for $15\frac{3}{4}$ hours, covering $298\frac{1}{8}$ miles.

Record of Pressures.

Pressures are given in lb. per square inch.

Tyre.	Initial pressures.	Fall in pressure after punctures.	Pressure at end of trial.	Loss of pressure during trial.
Off front ...	70 ...	Nil ...	64 ...	6
Near front ...	70 ...	Nil ...	64 ...	6
Off rear ...	75 ...	Nil ...	71 ...	4
Near rear ...	75 ...	Nil ...	(See note) ...	(See note)

After the near rear tyre had run thirty-two miles the bead of the cover blew off the rim, destroying the air tube. During the trial the valves of the tyres were tested and found not to leak.

"Herroline" Motor Fuel Energiser.

Entered by Messrs. J. B. Foote and Co., 146, Fenchurch Street, London, E.C. Date of trial: October 29th, 1913.

A quantity of standard commercial petrol was divided into two parts, and to one part was added "Herroline," which is a colourless liquid, in the proportion of one ounce to one gallon of petrol.

Distillation tests of the two samples of fuel, treated and untreated, were then made, and the following are the results:

R.A.C. Certified Trials.

	Treated	Untreated.
10% distilled below ..	74°C. ...	74°C.
20% ,, ,, ...	80°C. ...	78°C.
30% ,, ,, ...	87°C. ...	87°C.
40% ,, ,, ..	92°C. ...	94°C.
50% ,, ,, ...	99°C. ...	99°C.
60% ,, ,, .	104°C. ...	104°C.
70% ,, ,, .	113°C. ...	114°C.
80% ,, ,, ..	119°C. ...	121°C.
90% ,, ,, .	132°C. ...	133°C.
Specific gravity at 15.5°C.	.7135 ...	.7135

Comparative fuel consumption tests were made on Brooklands Tracks with the treated and the untreated fuel, no carburetter or other adjustment being made between the tests.

The car used was a 15 h.p. (16.7 R.A.C. rating) Napier, weighing 3.015 lbs. (27 cwt. approximately) with passengers. The following are the results of the test:

A.—Untreated Petrol.

No. of test.	Nominal speed.	Actual speed.	Consumption. Miles per gal.	Consumption. Ton-miles per gal.
1.	15 m.p.h. ...	15.1 m.p.h. ...	25.49	34.31
2.	20 m.p.h. ...	20.4 m.p.h. ...	24.56	33.06
3.	All out ...	32.9 m.p.h. ...	20.58	27.70

B.—Treated Petrol.

No. of test.	Nominal speed.	Actual speed.	Consumption. Miles per gal.	Consumption. Ton-miles per gal.
4.	15 m.p.h. ...	15.1 m.p.h. ...	25.81	34.74
5.	20 m.p.h. ...	20.3 m.p.h. ...	24.64	33.16
6.	All out ...	32.7 m.p.h. ...	21.28	28.64

During tests Nos. 1, 4, and 6, the weather was fine, and during tests Nos. 2, 3, and 5, there were showers. Temperature: Max. 64°F., min. 53°F.

Pettett's Safety Filler.

Entered by William Pettett, 46a, Regent Square, Brighton. Date of trial: November 7th, 1913.

The device consists of a curved spout, about 6in. long, fitted with a screw collar for attaching it to the fuel can. A filter gauze is provided at the outlet of the spout. An air tube which starts at the outlet of the spout is extended into the fuel can by screwing on (prior to attaching to can) a curved tube about 8in. long. A clip band, the position of which can be altered, encircles the spout. The band has a projecting piece which is intended to rest upon the edge of the filler-hole in the car tank.

The weight of the device was six ounces, including the loose air tube extension and an adapting collar to fit fuel cans with different size orifices. The overall dimensions (with the air tube detached) were 8in. by $2\frac{3}{4}$in. by $1\frac{1}{2}$in.

Two standard fuel cans were used for the tests, one with a small (1in.) orifice, and the other with a larger ($1\frac{1}{4}$in.) orifice. Two gallons of petrol were measured into each can before each test. The following table shows the results of the tests:

Poured out of	Time taken to attach device.	Time taken to empty can.	Time taken to detach device.
Large orifice can ...	$5\frac{2}{5}$s. ...	$20\frac{3}{5}$s. ...	$2\frac{1}{5}$s.
Small orifice can ...	$7\frac{1}{5}$s. ...	$23\frac{2}{5}$s. ...	$4\frac{4}{5}$s.

The time for detaching does not include the screwing off of the air-tube for packing. In every test the can was completely emptied. The large and small aperture cans were emptied in $42\frac{2}{5}$s. and 1m. 10s. respectively when the emptying was carried out in the usual way.

A test was made to show whether the fuel would cease to issue from the can when a pre-determined level in the tank had been reached. Instructions were given to the entrant to put 20 ozs. of fuel into a measure. The clip band was adapted, and the can was inverted and kept inverted over the vessel. When 20 ozs. had been passed into the vessel the fuel ceased to flow, and the action of removing the can did not cause any more fuel to leave the can.

Warland Dual Rims (Speed Test).

Entered by the Warland Dual Rim Co., Ltd., Alma Street, Aston, Birmingham. Date of trial: November 10th, 1913.

The rims were fitted to a 47.6 R.A.C. rating Sunbeam car, twelve cylinders, 80 mm. by 150 mm. The weight of the car with driver was 3,120 lbs. (28 cwt. approximately). The size of the tyres was 880 mm. by 120 mm., and each rim was fitted with four security bolts, the air tube having a bolt valve. The trial was held on Brooklands Track, and the speed attained over the flying half-mile was 119.213 m.p.h.

After the test the rims were examined, and everything was found tight and in good order.

R.A.C. Certified Trials.

The Blakoe Resilient Wheel.

Entered by the Blakoe Wheel Co., Ltd., 99, Ladbroke Road, Notting Hill Gate, London, W. Four wheels for a 2,000 miles test. Date of trial: December 10th to 23rd.

The wheel consists of three main parts: a steel rim, a gunmetal hub, and two steel springs. The last-named are two endless flat springs of trefoil shape and are so disposed in the wheel that the outer curves of the trefoils rest in cradles attached to the inner side of the rim and the inner curves rest in similar cradles in the hub casing.

The two springs are placed side by side and so arranged that an outer curve of one is in contact with the rim midway between the points of contact of the outer curves of the other spring.

The springs are kept in position by a flange bolted to the side of the rim and by a hub flange bolted up in the usual position. The springs are not attached in any way to either the hub or the rim.

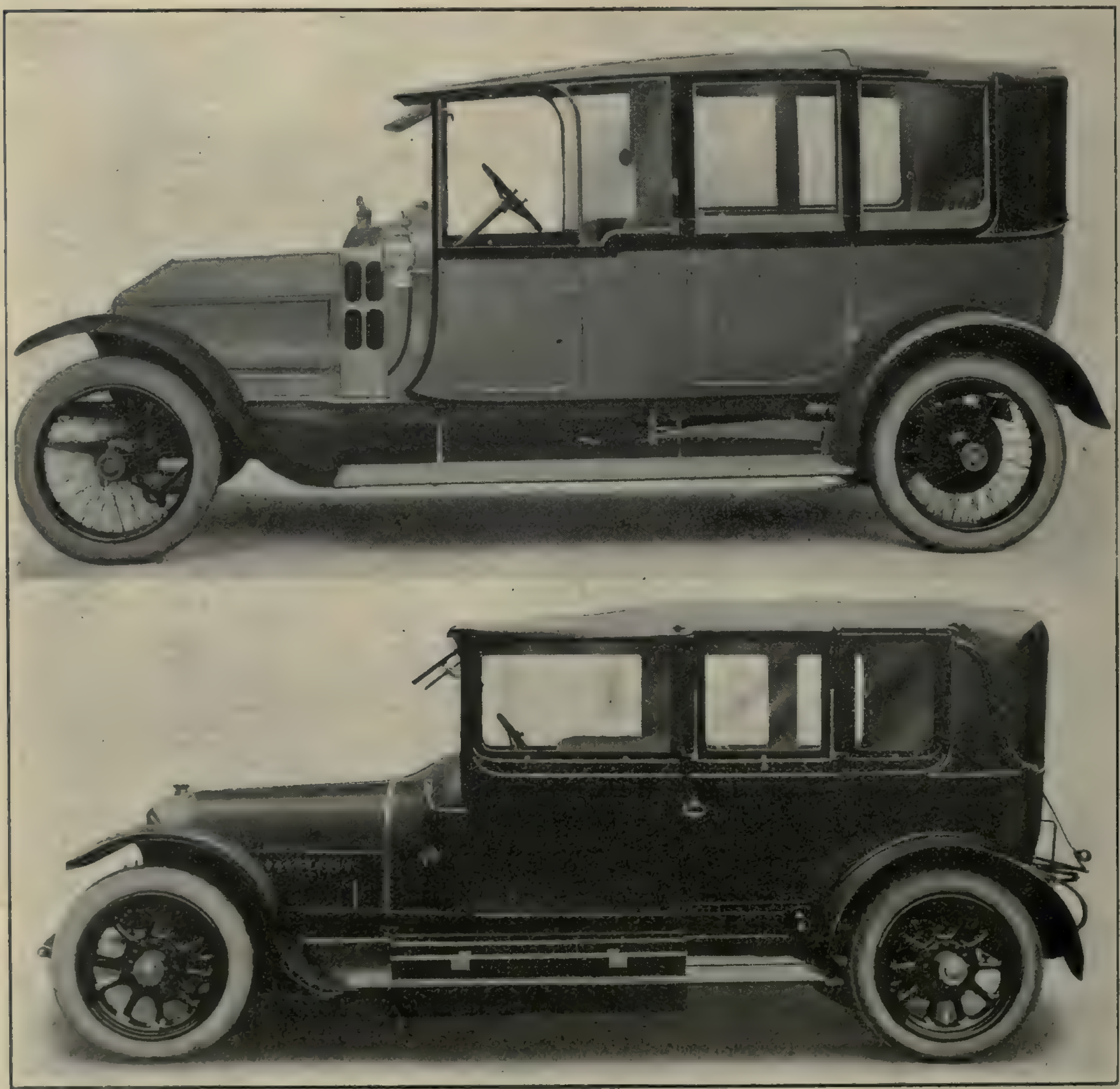
The weight of the complete wheel was 110 lbs. This does not include the hub centre (the wheels are detachable), the tyre cover or the inner tube. The size of the tyres, which were of the usual pneumatic form, but were filled with a solid filling, was 920 mm. × 120 mm.

The wheels were fitted to a 25-30 h.p. Vauxhall car (R.A.C. rating 22.4 h.p.), the running weight of which, including load, was 4,666 lb. (41⅔ cwt. approx.).

The trial was held over the Club's six standard routes, 2,000¾ miles being covered at an average speed (running time only) of 19.7 m.p.h. The weather during the trial was fine and the roads were in fair condition. Some rain fell on three days. During the trial no work of any kind was done upon the wheels, the distance being covered without incident.

After the trial the wheels were examined and everything found in good order. There were slight signs of wear where the springs were in contact with the flanges, and there was a very small amount of lateral movement.

Examples of British Coachwork.



(Top) A Connaught body of pleasing design mounted on a Siddeley-Deasy chassis. (Below) A convertible body by Salmons and Sons. It can be converted to an open car in a few minutes. A review of the progress made in body design and accessories will be found on pages 9 to 19

English-French Dictionary.

The Principal Motor Terms in Constant Use.

English.	French.
Accelerator	Accélérateur.
Accumulator	Accumulateur.
Adjusting screw	Vis de réglage.
Air pump	Pompe à air.
Air tube	Chambre à air.
Air valve	Soupape à air.
Alcohol	Alcool.
Ammeter	Ampèremètre.
Apron	Tablier.
Armature	Induit.
Axle	Essieu.
Backfire	Explosion prématuré.
Back wheel	Roue d'arrière.
Ball bearings	Coussinets à billes.
Band brake	Frein à tambour.
Battery	Batterie, pile.
Bearing	Coussinet, palier.
Bevel wheel	Roue conique.
Blacksmith	Forgeron.
Bolt	Boulon.
Bonnet	Capot.
Box spanner	Clef à douille.
Brake	Frein.
Brake drum	Frein à tambour.
Brake lever	Levier du frein.
Brake rod	Tige du frein.
Breakdown	Panne.
Bridge	Pont.
Burner	Bruleur.
Canopy	Dais.
Cap	Couvercle.
Carburetter	Carburateur.
Chain	Chaîne.
Chain wheel	Roue de chaîne.
Change speed lever	Levier de changement de vitesse.
Clutch	Embrayage.
Clutch pedal	Pédale de débrayage.
Clutch spring	Ressort d'embrayage.
Coil	Bobine.
Combustion chamber	Chambre d'explosion.
Compression tap	Robinet de compression.
Contact breaker	Interrupteur.
Copper wire	Fil de cuivre.
Counter-shaft	Contre-arbre.
Crank chamber	Carter.
Crankshaft	Arbre à manivelle.
Cylinder	Cylindre.
Cylinder head.	Culasse
Dangerous hill	Descente dangereuse.
Differential	Différentiel.
Drain cock	Robinet de purge.
Driving axle	Essieu moteur.
Driving chain	Chaîne de transmission.
Dust	Poussière.
Emery	Emeri.
Enamel	Email.
Engine	Moteur
Exhaust	Echappement.
Exhaust valve	Soupape d'échappement.
Exhaust valve spring	Ressort de soupape d'échappement.
Explosion	Explosion.
Fan	Ventilateur.
Felt	Feutre.
File	Lime.
Float	Flotteur.
Flywheel	Volant.
Foot brake	Frein à pédale.
Frame	Chassis.
French chalk	Talc.
Friction	Frottement.
Front axle	Essieu d'avant.
Front wheel	Roue d'avant.
Funnel	Entonnoir.
Gas	Gaz.
Gauge	Jauge, manomètre.
Gear	Engrenage.
Gear box	Boîte de vitesses.
Gloves	Gants.
Goggles	Lunettes.
Gradient	Pente.
Grease	Graisse.
Hammer	Marteau.
Handle	Manette.
Headlight	Phare.
Hood	Capote.
Horn	Corne.
Horn bulb	Poire.
Horn reed	Anche.
Horse-power	Cheval-vapeur.
Hot	Chaude.
Ignition lever	Manette d'allumage.
Inlet valve	Soupape d'admission.
Inner tube	Chambre à air.
Insulation	Isolation.
Jack	Cric.
Jet (carburetter)	Gicleur.
Key	Clef.
Lamp	Lampe.
Lamp bracket	Porte-lanterne.
Lamp oil	Huile à brûler.
Lamp wick	Mèche.
Lever	Levier.
Licence	Permit.
Link (chain)	Maillon.
Locknut	Contre écrou.
Lubricator	Graisseur.
Luggage carrier	Porte-bagage.
Magneto ignition	Allumage par magnéto.
Map	Carte.
Misfire	Raté.
Mudguard	Garde-boue.
Nail	Clou.
Non-skid	Anti-dérapant.
Nut	Ecrou.
Oil	Huile.
Oilcan	Burette.
Outer cover	Enveloppe.
Overheating	Surchauffage.
Paraffin	Pétrole
Petrol	Essence.
Petrol tank	Réservoir à l'essence.
Pin (split)	Goupille fendue.
Piston	Piston.
Piston ring	Segment du piston.
Piston rod	Bielle
Pliers	Pince.
Plug (sparking)	Bougie.
Pump	Pompe.
Puncture	Crevaison de pneumatique.
Radiator	Radiateur.
Reversing gear	Marche arrière
Revolution	Tour.
Rim	Jante.
Rivet	Rivet

ENGLISH.	FRENCH.
Rope	Corde.
Rug	Couverture.
Screw	Vis.
Screwdriver	Tournevis.
Shaft	Arbre.
Sideslip	Dérapage.
Silencer	Silencieux.
Soap	Savon.
Spanner	Clef.
Spindle	Fuseau.
Spoke	Rayon.
Sprag	Béquille.
Spring wheel	Ressort, roue à.
Sprocket wheel	Chaîne de pignon
Starting handle	Manivelle de marche.
Steering wheel	Roue directrice.
Switch	Interrupteur.
Tank	Réservoir.
Tap	Robinet.
Terminal	Borne.
Throttle	Réglage à main.
Toolbox	Boîte à outils.
Tools	Outils.
Tyre	Pneumatique.
Tyre lever	Demont pneu.
Universal joint	Cardan.
Valve	Soupape.
Valve seat	Siège de soupape.
Vice	Etau.
Voltmeter	Voltmètre.
Vulcanised	Vulcanisé.
Washer	Rondelle.
Water	Eau.
Weight	Poids.
Wheel	Roue.
Wick	Mèche.
Wire	Fil.
Workshop	Atelier.
Wood	Bois.

Speed per Hour.

The following Table shows the Speed per Hour in Miles and Kilometres when the Time for ⅛, ¼, ½, or 1 Mile is known.

Time for ⅛ mile.	¼ mile.	½ mile.	1 mile.	Miles per hour.	Kilos. per hour.
sec.	m. s.	m. s.	m. s.		
45.00	1 30	3 0	6 0	10.00	16.09
40.50	1 21	2 42	5 24	11.11	17.83
37.50	1 15	2 30	5 0	12.00	19.31
36.00	1 12	2 24	4 48	12.50	20.11
33.75	1 7.5	2 15	4 30	13.33	21.45
31.50	1 3	2 6	4 12	14.28	22.98
30.00	1 0	2 0	4 0	15.00	24.14
28.50	57	1 54	3 48	15.79	25.41
26.25	52.5	1 45	3 30	17.14	27.58
24.75	49.5	1 39	3 18	18.18	29.25
22.50	45	1 30	3 0	20.00	32.18
21.25	42.5	1 25	2 50	21.17	34.07
20.62	41.2	1 22	2 45	21.81	35.10
19.37	38.7	1 17	2 35	23.22	37 37
18.62	37.5	1 15	2 30	24.00	38.62
18.00	36	1 12	2 24	25.00	40.23
16.87	33.7	1 7	2 15	26.66	42.90
16.00	32	1 4	2 8	28.12	45.25
15.00	30	1 0	2 0	30.00	48.28
14.37	28.7	57	1 55	31.30	50.37
13.75	27.5	55	1 50	32.72	52.65
13.50	27	54	1 48	33.33	53.64
13.12	26.2	52	1 45	34.28	55.17

Time for ⅛ mile.	¼ mile.	½ mile.	1 mile.	Miles per hour.	Kilos. per hour.
sec.	sec.	sec.	m. s.		
12.75	25.5	51	1 42	35.29	56.79
12.50	25	50	1 40	36.00	57.93
12.25	24.5	49	1 38	36.73	59.11
11.87	23.7	47	1 35	37.89	60.98
11.62	23.2	46	1 33	38.71	62.29
11.25	22.5	45	1 30	40.00	64.37
10.87	21.7	43	1 27	41.38	66.59
10.62	21.2	42	1 25	42.35	68 15
10.25	20.5	41	1 22	43.90	70.65
10.00	20	40	1 20	45.00	72.42
9.75	19.5	39	1 18	46.15	74.27
9.37	18.7	37	1 15	48.00	77.25
9.00	18	36	1 12	50.00	80.46
8.75	17.5	35	1 10	51.43	82.77
8.12	16.2	32	1 5	55.38	89.12
7.50	15	30	1 0	60.00	96.56
6.87	13.7	27	55	65.45	105.33
6.25	12.5	25	50	72.00	115.87
5.62	11.2	22	45	80.00	128.74
5.00	10	20	40	90.00	144.84
4.37	8.7	17	35	102.85	165.52
3.75	7.5	15	30	120.00	193.12

Cylinder Bores and Strokes in Millimetres and Inches.

An Approximate Guide for Comparison.

Millimetres. Bore.	Stroke.	Inches. Bore.	Stroke.
70	130	2¾	5⅛
75	120	3	4¾
75	130	3	5⅛
83	86	3¼	3⅜
84	90	3 5/16	3 9/16
80	120	3 3/16	4¾
80	130	3 3/16	5⅛
80	135	3 3/16	5⅜
80	140	3 3/16	5½
80	150	3 3/16	5 15/16
85	135	3⅜	5⅜
85	120	3⅜	4¾
90	90	3 9/16	3 9/16
89	127	3½	5
90	120	3 9/16	4¾
90	130	3 9/16	5⅛
100	115	3 15/16	4 9/16
100	130	3 15/16	5⅛
100	140	3 15/16	5½
110	125	4 5/16	4 15/16
120	140	4¾	5½
124	146	4⅞	5¾
128	150	5 1/16	5 15/16
130	140	5⅛	5½

English and Metric Weights and Measures.

1 kilogramme	=	2.2	lbs. approx.
1 lb.	=	453.6	grammes.
1 lb.	=	.4536	kilogramme.
1 cwt.	=	50.8	kilogrammes.
1 ton	=	1,016	kilogrammes.
1 litre	=	1.75	pint approx.
1 pint	=	.568	litre.
1 quart	=	1.135	litre.
1 gallon	=	4.543	litres.
1 cubic foot	=	28.3	litres.
1 cubic metre	=	35.3	cubic feet.

Measures of Length.

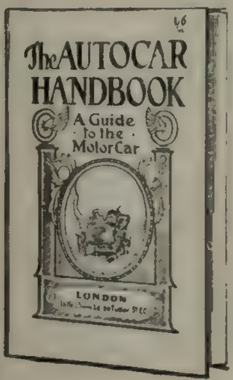
1 kilometre	=	.6214	mile, ⅝ mile approx.
1 metre	=	39.3701	inch.
1 centimetre	=	.3937	inch.
1 millimetre	=	.0394	inch, 1/25 inch approx.
1 inch	=	25.4	millimetres.
1 foot	=	30.48	centimetres.
1 mile	=	1,609.315	metres.

INDEX.

Classified Index to Advertisers.

∴ Books *for* ∴

Motorists, Motor Cyclists, etc.



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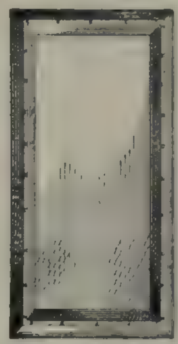

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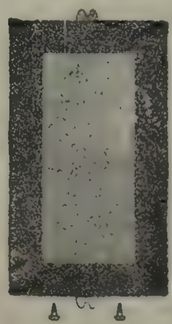

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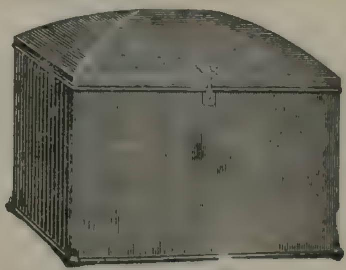

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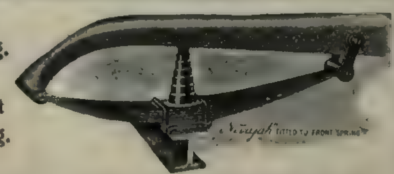

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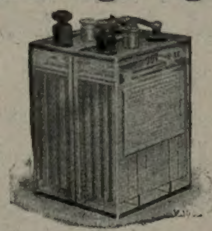

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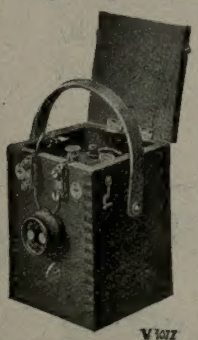

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